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PEELE'S

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THIRD REVISED EDITION

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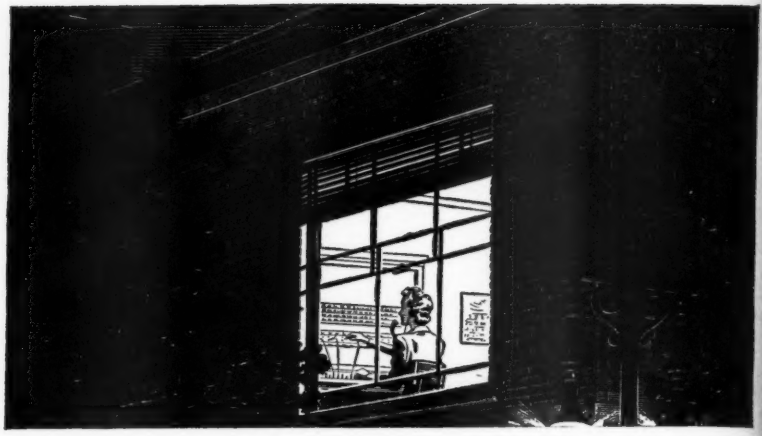

"I judge the telephone company by the people who work for it"

A little while ago a Vermont newspaper editor, John Hooper, commented on the telephone company and its people. His words express so well the ideals toward which we are striving that we quote them here.

• • •

"I DON'T know how big the telephone company is, but it is big enough to exceed my mental grasp of business.

"But I don't find myself thinking of it as a business, even in my day-to-day contacts. Rather, my attention is on the voice that says, 'Number, please.' I find myself wondering if that voice is feeling as well as it always seems to, or if it feels just as hot and weary as I do, and would say so if it wasn't the kind of voice it is.

"The first time the business angle really struck home was when I read that my friend Carl had completed thirty years with the company.

"Now it happens that I know something of those thirty years, and I believe they are a credit both to Carl and the big business for which he works.

"In 1907 Carl was a high school boy confronted with the need for earning money in his spare time. He happened to get a job as Saturday night operator in the telephone exchange. He worked at this job for three years and then entered the university.

"After graduation, he was hired full time by the telephone company, not in an 'executive' position which some folks think goes with a college diploma, but as a lineman.

"Within a year he was made wire chief of the district, a job which he held for the next ten years. He was then transferred to a larger city as manager of the office—then promoted to sales manager of the division.

"A year later he was sent to another State, as district manager. In less than a year after this appointment, he was made manager for the entire State.

"I don't know much about the telephone company as a business; I can only judge it by the people who work for it. Just where the dividing line is between a business and the people who work for it, I don't know. I don't think there is any line."

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ENGINEERING DEFENSE TRAINING—A SUMMATION

By ROY A. SEATON *

In this final issue of the JOURNAL for the academic year, it seems appropriate to review the development of the Engineering Defense Training program and to present data on accomplishments up to the present time.

The Act appropriating $9,000,000 for the program was approved on October 9, 1941. The program had then to be organized from a standing start. The central organization in Washington had to be created; policies and procedures determined; forms and instructions issued; regional advisers and committees appointed; and engineering schools, industries, and prospective trainees apprised of their opportunities and responsibilities under the program. Needs of industries for Engineering Defense Training had to be surveyed by the schools; proposals for courses had to be prepared; teaching and supervisory staffs for the courses had to be organized; and trainees had to be recruited before actual instruction could start.

The first preliminary proposals for Engineering Defense Training courses were approved on December 5, 1940. Instruction in a few classes began early in December, but most of the classes did not start until January or later. It is substantially correct, therefore, to say that the actual operation of the Engineering Defense Training program will cover only the latter half of the present fiscal year. Instruction in this program will not stop with the end of the fiscal year, however, since instruction in courses begun in June may be continued into next September.

Up to the present time, May 17, 1941, approvals have been given to 1,569 proposals for Engineering Defense Training courses in 137 engineering schools located in 46 states, the District of Columbia, and Puerto Rico. Actual enrollments in courses for which final proposals have been approved after two weeks or more of instruction total 57,074, while authorizations have been given for 43,375 additional trainees in approved preliminary proposals, or a total of 100,449 trainees, actual and authorized. Experience indicates a shrinkage of 10 to 15 per cent from preliminary authorization to actual enrollment, so we may expect a total of about 95,000 trainees

* Dean of the Division of Engineering and Architecture, Kansas State College, absent on leave to serve as Director of Engineering Defense Training in the U. S. Office of Education.

TABLE I

AUTHORIZED ENROLLMENT IN E.D.T. COURSES ON MAY 13, 1941
(By Classification of Course and Type of Authorization)

	Final Authorization	Preliminary Authorization	Total Authorized Enrollment
Aeronautical Engineering			
Fundamentals	836	355	1,191
Aircraft (Complete Planes)	470	885	1,355
Structures	2,623	1,165	3,788
Other	1,734	1,490	3,224
Total	5,663	3,895	9,558
Architectural Engineering	148	75	223
Basic Sciences			
Mathematics	737	215	952
Other	0	310	310
Total	737	525	1,262
Chemical Engineering			
Inspection and Testing	566	260	826
Explosives	737	1,132	1,869
Production	411	115	526
Other	442	567	1,009
Total	2,156	2,074	4,230
Civil Engineering			
Inspection and Testing	276	299	575
Structures	1,308	750	2,058
Surveying and Mapping	1,000	819	1,819
Other	759	439	1,198
Total	3,343	2,307	5,650
Electrical Engineering			
Fundamentals	504	468	972
Communications	866	499	1,365
Electronics	550	520	1,070
Other	904	588	1,492
Total	2,824	2,075	4,899
General Engineering			
Fundamentals	400	5,145	5,545
Eng. Drawing and Des. Geometry	11,859	3,450	15,309
Other	192	45	237
Total	12,451	8,640	21,091

TABLE I—*Continued*

	Final Authorization	Preliminary Authorization	Total Authorized Enrollment
Industrial Engineering			
Industrial Management	979	550	1,529
Production Engineering	5,724	3,836	9,560
Production Supervision	3,932	3,453	7,385
Other	716	690	1,406
Total	11,351	8,529	19,880
Marine Engineering and Naval Architecture			
Hulls	1,491	190	1,681
Equipment	333	150	483
Other	353	595	948
Total	2,177	935	3,112
Mechanical Engineering			
Fundamentals	1,038	660	1,698
Inspection and Testing	3,462	3,736	7,198
Internal Combustion Engines	315	575	890
Machine Design	3,142	2,583	5,725
Tools and Dies	2,079	1,880	3,959
Welding	300	325	625
Other	501	664	1,165
Total	10,837	10,423	21,260
Metallurgical Engineering			
Metallurgy and Metallography	2,134	2,962	5,096
Physical Metallurgy	545	195	740
Other	513	1,124	1,637
Total	3,192	4,281	7,473
Mining Engineering	95	0	95
Unclassified	87	690	777
GRAND TOTAL	55,061	44,449	99,510

in the courses already approved. Additional approvals are being issued daily, so a substantially larger total number of trainees may be expected under the present program.

The distribution of the authorized enrollment by classification of courses, by states, and by engineering schools on May 13, 1941, is shown in Tables I and II. It is apparent from these tables that the enrollment is concentrated largely in the branches of engineering in

TABLE II

AUTHORIZED ENROLLMENT IN E.D.T. COURSES ON MAY 13, 1941
(By States, Institutions and Type of Authorization)

Institution	Final Authorization	Preliminary Authorization	Total Authorized Enrollment
Alabama			
Alabama Polytechnic Institute	539	1,200	1,739
University of Alabama	—	2,251	2,251
STATE TOTAL	539	3,451	3,990
Arizona			
University of Arizona	18	—	18
STATE TOTAL	18	—	18
Arkansas			
University of Arkansas	41	—	41
STATE TOTAL	41	—	41
California			
University of California	1,532	2,890	4,422
University of Santa Clara	81	—	81
Stanford University	93	—	93
California Institute of Technology	409	372	781
University of Southern California	467	522	989
STATE TOTAL	2,582	3,784	6,366
Colorado			
Colorado School of Mines	189	—	189
Colorado State College of A. & M.	43	200	243
University of Colorado	501	517	1,018
University of Denver	278	135	413
STATE TOTAL	1,011	852	1,863
Connecticut			
University of Connecticut	1,288	565	1,853
Yale University	1,094	1,080	2,174
STATE TOTAL	2,382	1,645	4,027
Delaware			
University of Delaware	448	85	533
STATE TOTAL	448	85	533

TABLE II—*Continued*

Institution	Final Authorization	Preliminary Authorization	Total Authorized Enrollment
Florida			
University of Florida	581	815	1,396
STATE TOTAL	581	815	1,396
Georgia			
Georgia School of Technology	116	139	255
STATE TOTAL	116	139	255
Illinois			
Bradley Polytechnic Institute	157	55	212
Illinois Institute of Technology	1,357	4,049	5,406
Northwestern University	—	145	145
STATE TOTAL	1,514	4,249	5,763
Indiana			
Notre Dame University	261	120	381
Purdue University	954	5,504	6,458
Rose Polytechnic Institute	475	—	475
STATE TOTAL	1,690	5,624	7,314
Iowa			
Iowa State College	194	67	261
State University of Iowa	437	30	467
STATE TOTAL	631	97	728
Kansas			
Kansas State College	101	430	531
University of Kansas	198	535	733
STATE TOTAL	299	965	1,264
Kentucky			
University of Kentucky	143	10	153
University of Louisville	397	—	397
STATE TOTAL	540	10	550
Louisiana			
Louisiana Polytechnic Institute	42	—	42
Louisiana State University	68	—	68
Southwestern Louisiana Institute	16	—	16
Tulane University	170	—	170
STATE TOTAL	296	—	296

TABLE II—*Continued*

Institution	Final Authorization	Preliminary Authorization	Total Authorized Enrollment
Maine			
University of Maine	544	155	699
STATE TOTAL	544	155	699
Maryland			
Johns Hopkins University	679	—	679
University of Maryland	797	180	977
STATE TOTAL	1,476	180	1,656
Massachusetts			
Harvard University	25	—	25
Massachusetts Institute of Technology	447	265	712
Northeastern University	339	30	369
Tufts College	430	80	510
Worcester Polytechnic Institute	77	—	77
Massachusetts State College	42	—	42
STATE TOTAL	1,360	375	1,735
Michigan			
Lawrence Institute of Technology	—	285	285
Detroit Institute of Technology	44	—	44
University of Detroit	—	287	287
Michigan State College	—	156	156
University of Michigan	412	109	521
Wayne University	861	35	896
Michigan College of Mining & Tech.	74	25	99
STATE TOTAL	1,391	897	2,288
Minnesota			
University of Minnesota	272	275	547
STATE TOTAL	272	275	547
Mississippi			
Mississippi State College	48	80	128
STATE TOTAL	48	80	128
Missouri			
Missouri School of Mines & Metallurgy	61	85	146
Washington University	926	—	926
STATE TOTAL	987	85	1,072

TABLE II—*Continued*

Institution	Final Authorization	Preliminary Authorization	Total Authorized Enrollment
Nebraska			
University of Nebraska	155	125	280
STATE TOTAL	155	125	280
Nevada			
University of Nevada	34	—	34
STATE TOTAL	34	—	34
New Hampshire			
University of New Hampshire	108	95	203
STATE TOTAL	108	95	203
New Jersey			
Newark College of Engineering	524	410	934
Princeton University	60	—	60
Rutgers University	399	120	519
Stevens Institute of Technology	529	150	679
STATE TOTAL	1,512	680	2,192
New Mexico			
New Mexico State College	25	—	25
University of New Mexico	110	—	110
STATE TOTAL	135	—	135
New York			
Cornell University	1,238	975	2,213
Rensselaer Polytechnic Inst.	313	—	313
University of Rochester	198	345	543
Union College	709	—	709
Brooklyn Polytechnic Institute	—	140	140
College of the City of New York	261	28	289
Columbia University	125	256	381
Manhattan College	369	—	369
New York University	691	873	1,564
Pratt Institute	169	—	169
Defense Training Institute	362	—	362
STATE TOTAL	4,435	2,617	7,052
North Carolina			
Agri. and Tech. College	12	—	12
Duke University	27	40	67
North Carolina State College	475	144	619
STATE TOTAL	514	184	698

TABLE II—*Continued*

Institution	Final Authorization	Preliminary Authorization	Total Authorized Enrollment
North Dakota			
University of North Dakota	78	53	131
STATE TOTAL	78	53	131
Ohio			
University of Akron	441	82	523
Case School of Applied Science	749	480	1,229
Fenn College	360	329	689
Ohio Northern University	322	—	322
Ohio State University	691	593	1,284
University of Toledo	760	165	925
Antioch College	125	—	125
University of Cincinnati	385	50	435
Ohio University	301	275	576
STATE TOTAL	4,134	1,974	6,108
Oklahoma			
Oklahoma A. & M. College	47	165	212
University of Oklahoma	86	1,080	1,166
University of Tulsa	169	25	194
STATE TOTAL	302	1,270	1,572
Oregon			
Oregon State College	—	45	45
STATE TOTAL	—	45	45
Pennsylvania			
Drexel Inst. of Tech.	2,441	840	3,281
Lafayette College	235	50	285
Lehigh University	273	30	303
University of Pennsylvania	2,132	1,420	3,552
Swarthmore College	716	40	756
Villanova College	355	—	355
Bucknell University	142	—	142
Carnegie Inst. of Tech.	1,565	470	2,035
Grove City College	46	—	46
Pennsylvania State College	8,037	7,667	15,704
University of Pittsburgh	1,975	30	2,005
STATE TOTAL	17,917	10,547	28,464
Rhode Island			
Brown University	175	85	260
Rhode Island State College	147	45	192
STATE TOTAL	322	130	452

TABLE II—*Continued*

Institution	Final Authorization	Preliminary Authorization	Total Authorized Enrollment
South Carolina			
The Citadel	262	—	262
Clemson Agri. College	43	—	43
University of South Carolina	167	150	317
State A. & M. College	35	—	35
STATE TOTAL	507	150	657
South Dakota			
South Dakota State College	8	30	38
STATE TOTAL	8	30	38
Tennessee			
Tennessee Polytechnic Institute	—	35	35
University of Tennessee	422	—	422
Vanderbilt University	210	250	460
STATE TOTAL	632	285	917
Texas			
A. & M. College of Texas	101	510	611
Southern Methodist University	311	20	331
Texas College of Arts & Industries	36	70	106
Texas Tech. College	9	40	49
University of Texas	149	277	426
College of Mines & Metallurgy	16	—	16
STATE TOTAL	622	917	1,539
Utah			
Utah State Agricultural College	43	—	43
University of Utah	225	—	225
STATE TOTAL	268	—	268
Vermont			
Norwich University	60	—	60
University of Vermont	20	—	20
STATE TOTAL	80	—	80
Virginia			
Virginia Military Institute	84	90	174
Virginia Polytechnic Institute	650	—	650
University of Virginia	500	—	500
STATE TOTAL	1,234	90	1,324

TABLE II—*Continued*

Institution	Final Authorization	Preliminary Authorization	Total Authorized Enrollment
Washington			
Gonzaga University	21	—	21
State College of Washington	25	—	25
University of Washington	849	20	869
STATE TOTAL	895	20	915
West Virginia			
West Virginia University	1,759	25	1,784
STATE TOTAL	1,759	25	1,784
Wisconsin			
Marquette University	59	—	59
University of Wisconsin	20	—	20
STATE TOTAL	79	—	79
Wyoming			
University of Wyoming	16	130	146
STATE TOTAL	16	130	146
District of Columbia			
Catholic University of America	—	99	99
George Washington University	362	1,020	1,382
Howard University	118	130	248
TOTAL	480	1,249	1,729
Puerto Rico			
University of Puerto Rico	69	70	139
TOTAL	69	70	139
GRAND TOTAL	55,061	44,449	99,510

which the greatest demands for engineering services have been developed by defense activities, and in the areas of the country that are most active in defense production.

Only about 10 per cent of the trainees are enrolled in full-time courses. The remainder are taking part-time courses while, for the most part, they are engaged in "full-time" employment, either in defense or non-defense industries. While these part-time courses perform the indispensable functions of preparing the trainees for greater responsibilities in defense industries and of fitting for de-

fense activities those now engaged in other work, there appears to be need for more full-time courses which prepare new personnel quickly for engineering defense work. An excellent start is being made in this direction in the summer courses now being planned.

The engineering schools have done a magnificent job of developing this enormous program of Engineering Defense Training in such a short time. The contribution they have made to national defense is invaluable. Defense industries and governmental agencies are greatly pleased with the splendid results they have accomplished. But, despite their efforts, it appears that the "shortage of engineers with specialized training in fields essential to the national defense" is greater now than when the program started, because of the continued rapid expansion of defense activities. It is necessary, therefore, for the schools to make still greater efforts to provide competent technical and supervisory personnel for our defense activities. Many additional summer courses should be organized promptly, and tentative plans should be made now for a greatly expanded program next year.

ENGINEERING EDUCATION AND NATIONAL DEFENSE *

By THORNDIKE SAVILLE

Dean, College of Engineering, New York University

Again the world is aflame with war. As the conflagration approaches daily nearer to our shores, it becomes more and more apparent that technologically trained men constitute the greatest immediate problem in the efforts of this country to implement its own defense and to assist in the defense of other democracies. The failures abroad, as pointed out recently by Raymond Gram Swing, have been failures in training and in skills. The present war is a battle of men and machines. The dictators, he says, may be beaten by equal morale and better machines, or by better morale and equal machines. With the resources of this country, we should have both better morale and better machines. Both morale and machines are today largely dependent upon training and skills, and the kind of training and skills required in total war are largely technological in nature.

If this be doubted, consider the direction of the principal defense efforts created in this country. The Office of Production Management is headed in most of its branches by technically trained men. The armed services are eagerly seeking young engineering graduates as reserve officers. Even the new Defense Mediation Board has an engineer as chairman. The responsibility of the engineering profession is very great. Upon it falls not only the supply of engineers trained in engineering skills, but the direction of many more trained in vocational skills, and the supervisory duties attendant upon production. Machines and munitions, clothing and cantonments, radios and range-finders, these and many more are the ultimate responsibility of the engineer to produce. Having produced them, there is an equal task, ever increasing as production goals are reached, to maintain, to operate, to direct the employment of these products of his skill in the most effective and efficient ways.

Some of the implications of modern war upon the needs for technologically trained men were fortunately recognized in this

* An address before the Middle Atlantic States Section, S. P. E. E., Villanova College, May 3, 1941.

country fairly early in our defense efforts. In June 1940 the U. S. Office of Education secured an appropriation of $15,000,000 for vocational training in "courses of less than college grade." This was supplemented by a later appropriation of $44,000,000 for the same purpose. These sums have been expended through State Education Boards, and have been supplemented by an appropriation of $7,500,000 for vocational training of National Youth Administration beneficiaries. This total of $66,500,000 has been expended largely in the establishment of short intensive courses in vocational high schools, and to a limited extent in a few engineering schools. It is estimated that some 900,000 men and women will have completed these courses by June 30, 1941.

As the vocational training money became available in June 1940, efforts were made to have the engineering colleges of the country participate. A few did so, but most of them felt that the restriction of the training to work "of less than college grade" would prevent the effective utilization of their staff and facilities in more strictly professional undertakings which they envisioned as being required as immediate shortages in skilled workers were provided for and shortages in trained engineers became more acute. All of the eight accredited engineering colleges in New York City took this view, although two institutions with particularly suitable shop and drafting facilities participated in one or two courses.

In July 1940, the U. S. Commissioner of Education called a conference of some fifteen or twenty presidents and deans of engineering colleges throughout the country to discuss legislation for training courses on the engineering college level. Later Dean A. A. Potter of Purdue was engaged by the U. S. Office of Education to survey the needs of Government agencies and industry, and to assist in preparing a program of emergency engineering training. Subsequently the Congress authorized in October 1940 $9,000,000 for "the cost of short engineering courses of college grade . . . designed to meet the shortage of engineers with specialized training in fields essential to the national defense." The Act marks a new field of activity for the federal government, since even in the Land Grant Colleges federal funds for engineering colleges have been extremely small. Furthermore, it set a precedent for direct relationship between the U. S. Office of Education and the Engineering Colleges; all previous institutional relations with that agency having been through State Boards of Education.

To devise procedures for organizing the work contemplated by the Act, and to assist in its administration, the Commissioner of Education appointed an Advisory Committee on Engineering Defense Training consisting of Dean A. A. Potter as Chairman, Dr.

F. L. Bishop, President R. E. Doherty, Dean H. P. Hammond, Dean Gibb Gilchrist, President W. O. Hotchkiss, Dr. R. S. McBride, Dean Thorndike Saville, President C. C. Williams, and Dr. B. M. Woods.

Later, as part of the administrative machinery, the country was divided into 22 regions, and an engineering college administrator or faculty member within the region appointed as Regional Advisor. Their duties have varied from practically complete administration of all engineering defense courses in a region to acting merely as general representatives of the institutions in their area in dealings with the Office of Education.

Meanwhile the Washington staff of the Office of Education has been materially expanded to care for the engineering program. Two deans are attached full time as administrators, and the complete full time staff numbers at present about twenty persons. Unless it is much more unique than the history of federal bureaus would lead us to expect, it will continue to increase in personnel and authority.

Under the machinery set up by the U. S. Office of Education a total of between 80,000 and 90,000 men and a few women will have taken one of the some 1100 courses given by the 135 engineering colleges throughout the country which will have participated in this program up to July 1, 1941. Although there are about 1100 courses being given, of course the subjects taught are far fewer, and allowing for similarity in content there are only some 25 or 30 general types of courses. These include such specialties needed in national defense as aeronautical stress analysis, machine design, explosives, materials inspection, marine engineering, production supervision, tool engineering, and welding. They also include a number of specialties which appear to the writer as of dubious relation to serious shortages caused by defense undertakings, such as soil mechanics, concrete design, corrosion, highway engineering, power transmission, etc. The prerequisites vary from high school graduation to possession of an engineering college degree.

There is no cost to the student for tuition. The engineering colleges are in large part donating their facilities, and are reimbursed only for actual compensation to teaching staff and other out-of-pocket expenses. Many are obtaining substantial benefits by acquisition of needed equipment. To obtain reimbursement of these expenses from federal funds involves the usual difficulties with government accounting procedure, although the Office of Education has simplified these requirements to the minimum which they feel is possible.

Procedures Developed in New York Metropolitan Region

At the inception of this Government subsidized program of engineering training, nine engineering colleges in the vicinity of New York City undertook an investigation of the training needs of the region. A grant was secured from the Carnegie Foundation through the American Association for Adult Education, and a survey of 178 manufacturing plants representing 18 groups of industries was initiated.

A report was rendered in November 1940, and upon the information then available disclosed that the greatest need was in the aircraft industries of Long Island and Northeastern New Jersey. Here it was estimated that some 6000 technologically trained men would be needed within 12 months. The engineering colleges of the area graduate only about 1200 engineers each year, this being approximately one-tenth the number for the entire United States. From federal agencies came, and still come, requests for large numbers of specialists in fields in which the engineering colleges normally produce few trained men, such as marine engineering and ordnance inspectors. In other branches, as in production supervision, the potential demand was seen to far outrun the normal supply.

To meet this situation the engineering colleges of the region adopted two unique devices, which may well have far reaching implications in engineering education in the vicinity. The first was the establishment of a Defense Training Institute by the eight engineering colleges of the New York City area. The administrators of these colleges constituted themselves a Board of Directors of the Institute, which was organized to give sub-professional training on a pre-employment basis under the joint sponsorship of the colleges and financed by federal funds. In essence this Defense Training Institute is designed to provide sub-professional trainees for employment by defense industries, particularly the aircraft industries of Long Island. It is a novel experiment, conceived to meet a definite emergency situation with minimum interference with the normal and defense training programs of the colleges. This group effort in New York City, which has been carried out with the greatest harmony and with novel instructional procedures, is a most stimulating development.

In the second place the administrative heads of the twelve engineering colleges of the Metropolitan New York Region, eight in New York City and four in eastern New Jersey, formed an association to enable them to meet as occasion required to consult not only on the defense training programs, but on any matters of mutual concern. This association has acted as a clearing house for exchange of views dealing with defense training courses, with reflec-

tion of joint sentiment to federal agencies, with deferment of students, and with general engineering education problems affecting the region. It also is an unique development having promise of much future usefulness through cooperation and understanding.

Due to the concentration of sub-professional courses in the Engineering Defense Institute the engineering colleges of Greater New York have been able generally to confine their E. D. T. courses to a junior, senior, or graduate college level. However they are not generally of a character to be credited toward an engineering degree. No college credits have thus far been granted for any of these courses. They have served largely either as up-grading courses for men already employed in industry, or as refresher courses to qualify men to take specialized civil service examinations, or as re-orientation courses to enable an engineer trained in one branch of engineering (as structural engineering) to qualify in another but related branch (as in aeroplane stress analysis).

One of the interesting commentaries on the Engineering Defense Training Program is the high calibre of the students, the earnestness of their work, and the continuity of their study. Considering that tuition is free, that there is no guarantee of employment nor compulsion to continue in attendance, and that standards of instruction are rigorous, it is notable that less than 10 per cent have dropped out of the courses, many of which have been completed and others in progress for several weeks.

Effects of Emergency Upon Students

It seems inevitable to the writer that both the general emergency, and the emergency defense training program, may have certain effects upon the normal registration and programs of the engineering colleges. One is the possibility of decreased registration due to three factors: (*a*) induction of students under the Selective Service Act, (*b*) a feeling of defeatism by present or prospective students whereby they consider a college education (even in engineering) too precarious to warrant the effort (mental and financial) and seek immediate employment at good wages in a defense industry hoping for deferment on that score; and (*c*) the temptation to take free engineering defense courses with the objective of securing immediate deferment and (in the case of upperclassmen) receiving the equivalent, or sufficiently the equivalent, of regular engineering training to qualify indefinitely for technological positions. It is the duty of the engineering colleges to counteract each of these possible tendencies.

The problem of induction of regular engineering college graduates is dependent upon the interpretation given to regulations of

the Selective Service Act by local draft boards. Recently the situation has been potentially alleviated by instructions sent from Selective Service headquarters, calling the attention of local draft boards to the responsibilities which they have, "as they must not only select those who are needed by the armed forces, but must also defer those who are necessary to the production of defense materials." The instructions point out that while no occupational or group deferment is permissible, "the national industrial training program can be protected from unnecessary interruptions by carrying out, with due regard for the acute national need for such training, the intent of the phrase in Paragraph 352*a* (of the Regulations) which provides for the deferment of those 'in preparation or training' for a necessary occupation or activity necessary to the national interest."

On April 21 a still more emphatic notice was sent to State Selective Service Directors by General Hershey, quoting a memorandum from the Office of Production Management calling attention to the "dangerously low level" of "manpower in the specialized fields" and listing most branches of engineering.

To maintain the training programs so essential to national defense, and in consideration of the interpretation of the Selective Service Act Regulations given by the Deputy Director of Selective Service on February 21, March 7, and April 21, 1941, it is clear that it becomes a patriotic duty for executives of engineering colleges to request deferment of junior, senior, and graduate students in engineering who give promise of becoming more useful to the country's emergency activities after graduation than they would be if inducted into the armed services prior to graduation.

It follows that if the engineering colleges are to continue to prosecute both the normal and emergency training programs, their teaching staffs must be protected in considerable measure. These staffs will be, and have been, depleted by calls to active duty of reserve officers, and by leaves for special assignments on defense activities. Those not so called should be deferred from induction, at least in so far as those in the grades of instructor and higher are concerned.

It is clear that Selective Service Headquarters and State Directors have been made fully aware of the importance of deferment of students in training for engineering positions, either in the military services or in industry. The draft boards, however, are supreme (subject to appeal), and will be governed largely by public opinion.

It is to be hoped that public opinion, as represented by such groups as this, will exercise their considered influence upon local draft boards, to the end that such boards may interpret broadly

and wisely the suggestions they have received from headquarters as to deferment of those in training or necessary to training for activities essential to the national interest.

Government agencies and industry alike have made it clear that the free tuition emergency defense programs are expedients designed to produce quickly an increase in technologically trained personnel, and they have insisted that the foremost duty of engineering colleges is to continue to provide acceptable graduates from the regular four year curricula. There are no short cuts to the practice of professional engineering. The demand for such graduates is likely to exceed the supply for some years to come, and those able and capable of pursuing such curricula will be unwise to be enticed from this objective by the availability of certain tuition free courses of a technological character. A notice to this effect has recently been sent to all high schools of the Metropolitan Region by the Association of Engineering College Administrators.

Procedures of this kind are desirable to keep before the minds of qualified candidates for the regular engineering curricula the important facts as to increased needs for engineering graduates.

A concomitant of such efforts is the necessity upon the part of the engineering colleges and the Office of Education to keep to a minimum engineering defense courses which parallel courses offered for degree credit. This subject is discussed at greater length elsewhere in this paper.

Problems Arising Out of Defense Training Program

The Engineering Defense Training Program was hastily conceived to meet a developing emergency. In essence the types of courses being given still follow the outlines prepared by Dean Potter as a result of his canvass of the situation nearly a year ago. That in general they have proved satisfactory and useful is testimony to his energy and judgment. While some courses are probably not justified and should be abandoned, the writer has changed from a sceptic to an advocate with respect to the program as a whole. It has been amazingly successful from the standpoints of types of courses, administrative procedure, and contribution to national defense needs considering the haste with which it was undertaken and the novelty of its character.

However, aside from minor changes which experience has already indicated, there are a number of major considerations of policy which the writer feels need immediate attention.

The first is more effective coördination between the Office of Education and government agencies needing engineers. The situation in sanitary engineering is one example. Nearly a year ago

responsible officers of the U. S. Public Health Service and of the Sanitary Corps of the Surgeon-General's office told the writer that no training programs were contemplated other than those used in peace time, and that no difficulty was expected in securing adequately trained sanitary engineers from state and local government agencies in case of emergency. Wholly aside from the questionable merit of a policy predicated upon robbing important civilian health units, the inability to secure enough adequately trained sanitary engineers to meet an emergency would appear obvious. Two weeks ago some of the very persons approached, publicly stated that the procurement of such trained personnel had become a serious problem. But even yet there is no provision whereby the E. D. T. program can be made really effective in this situation.

Another case relates to the need for inspectors of ordnance supplies. It has been stated that several thousand such inspectors will be needed within a year. Where are they to come from? Present civil service regulations (established by War Department dictum) require in effect two years of engineering college training or two years of inspection experience. By a strange quirk of the bureaucratic mind, a 12 weeks' E. D. T. course in inspection of materials is considered the equivalent of one year of the required engineering college courses, while at the same time a graduate of a liberal arts college who specialized in physics, mathematics, and chemistry would not be eligible to take the examination even if he took the E. D. T. course. Confronted with an alleged serious need for inspectors, even on the junior level, some forceful liaison work seems called for.

Engineering research represents still another field in which constructive action might be taken by those administering federal educational policies connected with national defense. The National Defense Research Committee was constituted nearly a year ago and consists of distinguished scientists from the Massachusetts Institute of Technology, Harvard University, California Institute of Technology, the Bell Telephone Laboratories, and the Carnegie Institution of Washington, plus three federal representatives. Bearing the membership of this committee in mind it is interesting to note the distribution of research projects assigned by the committee and reported in Science for November 22, 1940 and April 11, 1941. Of 294 investigators named, 113 or 38 per cent are from the five institutions mentioned, 58 or nearly 20 per cent being from M. I. T. alone. Aside from investigators at these five institutions, Princeton, Chicago, Illinois, Colorado, California, Ohio, and Michigan have five or more investigators. Such notable engineering institutions as Texas, Case, Cincinnati, and Rensselaer have none. Purdue

and Brooklyn Polytechnic Institute have only one each. Of course, of the investigations assigned, those in engineering sciences are doubtless in the minority, but one wonders if the forty-one institutions represented by investigators out of 155 accredited engineering schools do not indicate a concentration of research efforts which might be spread more advantageously among a larger number of institutions with qualified staff and facilities.

Other inconsistencies could be cited, which would be ridiculous if they were not likely to be tragic. There is required imagination and courage upon the part of those concerned with educational administration, and understanding and adaptability upon the part of the officials in other federal agencies and industry.

Possible Duplication of Regular and E. D. T. Courses

Another problem requiring serious consideration is duplication of regular engineering degree credit courses by E. D. T. courses. On the subprofessional level, as engineering drawing, mathematics, physics, and shop work, such duplication is to a large degree unavoidable. Shall we admit high school graduates to these tuition free courses and later grant college credits? There are sound arguments pro and con which are beyond the scope of this paper, but the implications upon the academic and financial integrity of the freshman and sophomore years warrant serious consideration.

Upon the upper levels of engineering instruction, duplication of course content is even more important. Is it likely that students provided with free tuition courses in the technological subjects of the freshman and sophomore years will turn up a year or two hence in E. D. T. courses in materials of construction, thermodynamics, metallurgy and airplane stress analysis, all now given in the E. D. T. program? And if so, is the step toward a demand for an additional free tuition program sufficient to qualify for a degree too remote for consideration now? The writer believes not.

Even now the E. D. T. program is beginning to include quite highly specialized courses on the graduate level. Such free E. D. T. courses in the writer's own institution are already competitive with regular graduate courses on the tuition basis. The chief difference is one of degree credit and that is a small hurdle to jump under sufficient pressure.

These are real problems, vitally affecting the future of engineering education, and it is none too soon now to begin to study them with the utmost care.

Federal Relations to Engineering Education

It is probable that the Engineering Defense Training program of the U. S. Office of Education will be continued for at least another year. In addition to the $9,000,000 appropriated this year there is to be requested some $20,000,000 for next year. The 80,000 students receiving free tuition this year may be at least doubled next year. Over a two-year period the expenditure of $29,000,000 for the free instruction of some 270,000 students in engineering subjects is bound to have some implications upon the future of engineering education generally. Manifestly the expenditure of such sums of federal money will be (and has been) accompanied by a measure of federal control. Those who have been the recipients of such training may well form the nucleus of a group who will demand further subsidization of engineering education at government expense and with the concomitants of bureaucratic control and regimentation.

In all fairness it must be said that thus far little evidence exists of any intent to utilize the engineering defense program as a means toward control of engineering education. The Office of Education has a reasonable regard for institutional autonomy in the conduct of defense training courses, and such troubles as have arisen have been due to delays and scrutinies probably inevitably associated with a new undertaking rather than to major decisions of a policy making nature. Indications to date evidence an intent by those engineering colleges participating in the program from patriotic motives to resist promptly and vigorously any incursions by public authorities into engineering educational control not fully warranted by the temporary emergency nature of the undertaking. The situation appears under control at the moment, but it is fraught with dangerous implications for the future which will warrant careful and continuous scrutiny by the engineering societies.

The need for such watchfulness is illustrated by the suggestion for acceleration of the normal four year engineering curricula by causing students to work through the summer months, so that ultimately a class could be graduated in three years. Sponsored by a few persons acting in part from patriotic motives and in part from a realization of advantages to accrue from federal subsidy for the regular students during three summers (the plan was predicated upon this), the idea was squelched only after considerable effort had been expended to show that both government agencies and industry felt the plan to be unsound. It has been abandoned for the present.

Continuation of federal subsidy for engineering courses of college grade will become more difficult to administer justly and for

defense needs alone as time goes on. Political considerations may enter; geographical, institutional, and regional claims and benefits may subtly supersede bona fide defense requirements; and the stronger, well equipped, well staffed institutions may find themselves hard put to maintain their utility and independence in the face of mediocrity enthroned by federal bounty. Present immersion in national defense undertaking should not be permitted to obscure consideration of trends likely to endanger the future independence of engineering education upon which the welfare of the country depends quite as much as upon immediate emergency training.

It is evident that the U. S. Office of Education with the hearty coöperation of most of the engineering colleges of the country has embarked upon very large scale undertakings in attempting to train men for various kinds of defense employment where engineering skills are needed. The writer believes that within a month or two, when most of the first groups of short courses will have been completed, a rigorous stock taking should be undertaken. Questions to be resolved will be not only the extent to which the trainees have been usefully absorbed in defense activities, but the broader inquiry as to whether the present system, rather hastily devised, should be materially altered. Such an inquiry will doubtless be pursued, in part at least, by the Office of Education.

There appears at present to be lacking an adequate correlation between demonstrated and specific needs in different regions with the character of courses offered in these localities. It is desirable that liaison between the Office of Education, the Office of Production Management, the military services, and other federal agencies should be closer and more effective. Conceivably, in the difficult times ahead, a greater degree of responsibility for indicating engineering personnel needs should be assigned to some agency such as the O. P. M. which is quite outside either the Office of Education or the engineering schools, to decide what emergency courses should be given, when they should be given, and under what conditions they should be given, in the interest of avoiding regional or institutional claims and promoting the needed training in the most necessary places with due regard to institutional facilities and staff. Such a type of direction would have the great merit of being set up for emergency purposes only, and there might exist real hope that it would cease with the expiration of the emergency.

Engineering education is properly a vital concern of the engineering profession. Engineering educators, engineering colleges, and the engineering profession have shown a high degree of cooperation with and an effective response to the necessities of emergency defense training as prompted by the requests from gov-

ernment and industry. As time goes on new ideas will be advanced. The emergencies of war time will some day merge into post war emergencies in which the capacities of the engineer will be no less needed than now. The part which the engineer must play in post war economy should be envisioned early. The inevitable changes in engineering education which must be devised to meet these new conditions can be brought about best if the engineering colleges are free from federal control. The preservation of the private engineering institutions from any further degree of public control than is now imposed is regarded by the writer as essential to the preservation of the engineering profession among a free people. Engineering should never become a stereotyped profession, either in education or in practice. Engineering education will retain its independence only if the profession, as represented by the professional societies, understand its problems and support its freedom from bureaucratic control.

We, as engineering educators, have a great responsibility to the profession and to the country. One duty which we owe to the profession is to acquaint it with problems which confront us. From time to time we should discharge that responsibility by reporting to the engineering societies and to the public upon the "state of the nation" respecting engineering education and the emergency. In many respects the present situation is more difficult than in 1917, if for no other reason than that we have had experience of the aftermath of war. Sanity and sagacity are needed, calmness and realistic appreciation of not only the emergency demands upon engineering education, but the long range view which will enable us to train engineers for the ultimate welfare of the individual and the nation.

SELECTIVE SERVICE DEFERMENTS FOR ENGINEERS

By J. H. POUND

Professor of Mechanical Engineering, The Rice Institute

At the request of the Southwest Section of the Society for the Promotion of Engineering Education, a conference was held recently between ten representatives of this Section and twenty officers from the Texas Selective Service System headquarters. The resulting long discussion clarified in the writer's mind a number of conditions related to procedure when deferment of engineers seems desirable. Though this discussion was initiated with the needs of engineering students and faculty in mind, it covered eventually a much wider group of college men.

The general principles behind deferment can be stated simply: local boards are required to determine for each individual that use of his talents which will contribute most to the national good. Deferment of military service is granted only to a "necessary man," who is further defined as one "engaged in any activity which is essential to the national health, safety, or interest in the sense that a serious interruption or delay in such activity is likely to impede the national defense program." The law provides also for deferment of men "in preparation or training" for a necessary occupation. But differences of opinion arise in applying these rules to specific cases.

A major cause of the discordant rulings of local boards is lack of complete evidence of a registrant's necessity to national defense. This need should receive the most careful attention when applications for deferment are made.

The non-technical personnel of boards should certainly be considered. This characteristic justifies presentation to them of data or arguments which can easily appear to engineers as such common knowledge or so obvious a conclusion as to require slight mention or none at all. Every man who hires or places engineers knows how prone are many of these men to present an incomplete picture of their qualifications. Apparently a somewhat similar situation exists in the deferment requests, though lack of personal data or failure to use terms understood by the local board are not the most serious deficiencies. The problem is seriously complicated by the ignorance of local boards as to the national needs for technical men and the necessary training for such men. Some boards have said "We have no knowledge that a shortage of engineers exists." For

each registrant or his employer to supply his local board with data on national defense needs, stated in non-technical terms and in convincing detail, may seem a good deal of labor; yet it may be the only safe course if results are really wanted. Some local boards say they have not seen the very clear memoranda issued by General Hershey to all state directors February 21 (covering skilled workers) and March 7 (covering technical and scientific students). In preparing deferment requests, consideration should be given to the wisdom of furnishing boards with quotations or reprints of such memoranda from Washington or state headquarters or the opinions expressed by national engineering societies or statements of needs for special skills issued by the U. S. Civil Service, the various employment services, or the E. D. T. headquarters. In the case of students, a letter from an employer promising employment in an important industry when schooling is complete has proved effective in establishing the "in training" status of a student. A good general rule in preferring deferment papers seems to be: in case of doubt, give too much data rather than too little.

Local boards may fail to understand the grading systems of schools, and it is most probable that a student will not receive deferment unless his academic record is established as a good one. Probably words are better descriptions of his standing than symbols or even per cents. How close he is to finishing his schooling must also be proved in unmistakable language.

Another good rule is: do not assume that some one else has furnished the board pertinent data. In some states, the state headquarters itself has sent each board brief mimeographed descriptions of national needs in the professions. It is also true that the appeal officers assigned each board have considerable data on national needs; but these data are often not in the hands of the boards. Often these appeal officers feel very reluctant even to appear to be interfering with the boards until the board has acted and the registrant has made his formal appeal. But if a man's deferment is really important, sufficient care should be exerted originally to secure a proper decision on the first attempt, if the proper statement of the case is all that is required.

One impression which the request should avoid is that of asking for deferment of a group. This practice of blanket deferment is forbidden by statute, and most local boards are very careful to avoid criticism on these grounds. Any request for deferment which contains an intimation that a whole group ought to be deferred probably has poor diplomatic phrasing.

Another unfortunate phrasing which has caused trouble for universities is one emphasizing their financial difficulties in competing with industry or the armed forces, a difficulty which now

appears when securing graduate assistants or instructors. The local boards very properly hold that defense value takes precedence over any other need, even university finance. Special ability of the man is, of course, a different argument.

A rather obvious mistake is permitting requests for deferment to be made by too many officers in an organization. The reputation of a school or a firm with local draft boards as an impartial source of reliable and patriotic data can be as valuable as its reputation among employers for reliable descriptions of its graduates; and such a reputation can be damaged easily if too many department heads handle deferment requests. Boards have complained of schools (usually of the commercialized vocational types) which try to maintain a high enrollment by deferment or who come close to advertising that deferment automatically accompanies their instruction. Boards have discovered deferment requests apparently based on both slight and fraudulent grounds, *i.e.*, money owed the employer, also cases where very short training periods apparently transformed laborers into extremely valuable men; and where scepticism develops in a board for any reason, even innocent errors could arouse unfortunate prejudices. Thus the responsibility for such requests ought to be concentrated in one man, and the local boards should be informed of this officer's identity. He should, of course, be both genuinely patriotic and tactful. Perhaps it is wise for him to avoid the suspicion of blanket or wholesale deferment requests even to the extent of not using forms for presenting personal data.

One of the easier types of deferment for a college to secure will probably be the engineering teacher, though as always group deferment will not be allowed and each individual must be presented as a separate case. In some states the deferment of even public school teachers has been general. It should not be hard to establish in the minds of local boards a national need for engineers with complete schooling, for both the armed forces and the defense industries need the completely trained man. As a corollary, it follows that the country needs the services of that special type of engineer who makes the best engineering teacher. But supplying inadequate arguments to support these two propositions should not be risked. It may be necessary to face the argument "Six months deferment is long enough in any case to locate a new substitute." A story is told of a state director who proposed the substitution of women for men on the engineering faculty. If true, it is one more illustration of a well-established fact: a considerable burden must be assumed by teachers in informing local boards, and some of us must share with these men the responsibility for a sensible and unbiased solution of the deferment problems.

THE MEETING IN MICHIGAN

IVAN H. WALTON

Summer is here and June vacations and also the time set for the 49th Annual Meeting of the Society for the Promotion of Engineering Education, which, this year, is being held on the Campus of the University of Michigan in Ann Arbor. A program committee has been at work for several months arranging a diversified schedule of activities that promises to be highly beneficial to all concerned. As mentioned in a previous issue of the JOURNAL, the College of Engineering of the University has much in the way of special equipment to exhibit that should be of interest to both teachers and practicing engineers. In addition, there are located in nearby cities within short driving distance of Ann Arbor, industrial developments that embody many triumphs of engineering, and about the state, especially on and about the Great Lakes, are unsurpassed vacation possibilities.

Within an area all less than two hours' driving distance from Ann Arbor is the center of the American automobile industry, and here are exemplified most of the automobile engineering wonders of the age. On the outskirts of Dearborn, 30 miles to the eastward, is the great home of the Ford Motor Company. In the City of Detroit, a few miles further east, are the plants from which the Chrysler, Dodge, De Soto, Plymouth, Hudson, and Packard cars are made, and here also is the main plant of the Fisher Body Company. An hour's easy drive northeastward from the Campus, in the City of Pontiac, is the home plant of the automobile of the same name, and of the G.M.C. trucks, and nearby in Flint are the main plants of Buick and Chevrolet. From Lansing, the State Capitol, and home of Michigan State College, come the Reo and Olds products. Other Michigan cities in the area, such as Saginaw, Bay City, and Jackson; and across the state in Grand Rapids and Muskegon are feeder plants that supply the big companies with parts. In the Lake Erie port of Toledo, Ohio, just a few miles from the Michigan border is built the Willys car, and here, too, is the main plant of the Libbey, Owens, Ford Company, makers of safety glass for automobiles and also plate glass, building blocks and other glass specialties.

The Program Committee has arranged tours of inspection through the Plymouth and Ford plants and through the Chrysler

A Rugged Lake Superior Shore.

Engineering Laboratories and the General Motors Proving Ground. Those who visit the Plymouth plant will be shown the complete process of building a modern automobile. In the Ford plant visitors will be shown the most modern ore-unloading machinery at work removing iron ore from the hold of a Great Lakes freighter, ten tons at a grab. They will also see at work coke ovens; foundry; forge shop; steel mills; and the glass, rubber, and plastics factories; and other important units of this great modern manufacturing establishment. Those who are fortunate enough to visit the famed Chrysler Engineering Laboratories will see demonstrated one of the industry's most complete and up-to-date collections of high precision apparatus for testing the raw materials and manufactured parts of today's automobile.

The unique General Motors Proving Ground, near the village of Milford about 30 miles out of Ann Arbor, covers 1268 acres and is equipped with repair shops, store rooms, and laboratories, a 3.8-mile main speedway, and other liberal samples of every known type of highway construction, some of it built of paving blocks imported

from abroad. These roads contain both sharp and easy curves and grades up to 25 per cent. Visitors here will see stock cars of every obtainable type, both domestic and foreign makes, being given carefully controlled performance tests of about every conceivable kind.

Lower Michigan's leading industry is the manufacture of automobiles, but the region has some notable examples of other types of engineering. Outstanding among these is the production of the Detroit plant of Parke, Davis and Company, one of the world's leading manufacturers of pharmaceutical materials on a large scale and under scientific control.

The recently developed oil industry in central Michigan has led to the establishment of a number of refineries. Notable among these is the thoroughly modern plant of the White Star Refining Company at Trenton. It utilizes a Houdry Catalytic unit. From Battle Creek comes a large part of the nation's diverse supply of breakfast foods. Here are located the Postum and Kellogg plants; and in Grand Rapids have been established for several generations some high ranking furniture factories.

Passing notice may well be taken of the region's salt-refining industry. On either side of the Lower Peninsula, particularly along the St. Clair River on the east, and at Manistee on the west, where the saucer-shaped Salina rock formation comes near the surface of the ground, are salt wells and refining plants. Within the city limits of Detroit, however, is the only rock-salt mine in the Middle West. Here a little more than 1100 feet down is a 26-foot vein that is being profitably mined in a manner very similar to that applied in modern coal mining. Mined out "streets" under the city total more than twenty miles in length.

Aeronautical engineers will no doubt be much interested in the equipment at Selfridge Field at Mt. Clemens, Michigan, the home of the First Pursuit Group of the U. S. Air Force. These squadrons are equipped with the most up-to-date American fighter planes. No assurance can be given under present international conditions, however, that visitors will be allowed on the Field.

Many of those attending the meeting in Ann Arbor will, no doubt, wish to take advantage of the opportunity to visit near-by Ontario. Canadian regulations governing tourists are at present exceedingly liberal, the money exchange rate is favorable, the attractions many, and the facilities for crossing either the Detroit or St. Clair river are excellent. The Ambassador Bridge at Detroit was, during the first years of its operation, the longest single-span suspension bridge in the world. A traveller crossing it is afforded an excellent panoramic view of the Detroit and Windsor waterfronts and of the parade of shipping on one of the world's busiest

THE PICTURED ROCKS NEAR MUNISING, MICH.

waterways. Those who prefer to cross by means of the two-lane, mile-long, twenty-four million dollar Detroit-Windsor Motor Tunnel will have an opportunity to inspect this highly creditable accomplishment of engineering. During construction, nine steel tubes 31 feet in diameter and 250 feet long, and lined with 18 inches of concrete were towed to their proper place in the river and lowered to a prepared trench on the river bottom, and then the approaches on either side of the river were excavated to a depth of 95 feet below the surface and connected to the under-river tubes. The tunnel, completely equipped with modern conveniences and safety devices, has a capacity of 2000 vehicles an hour. Any visitors to Canada who wish to cross at Port Huron will have at their convenience the new Blue Water international bridge.

No account of the advantages Michigan has to offer summer visitors would be at all complete without some mention of the attractions and outing possibilities provided by the Great Lakes which almost surround both peninsulas of the State. They are approximately equal to the British Isles in area; and Superior is over 1200 feet deep in some places. They have perceptible tides and currents, occasional tidal waves, and water spouts, and at times in late autumn, storms arise that the great steel freighters cannot withstand. Newspaper men regularly learn of giant sea serpents in them, visiting bachelors find mermaids along all the summer beaches, and many thousands of weary city dwellers gain a new lease on life from a summer vacation within sound of their ceaseless waves.

Their history is marked by both romance and tragedy. Recent archaeological discoveries prove that native Indians lived along these shores before the Christian era. Within historic times two savage eruptions of local tribes have devastated the area. Their descendants still live about the Upper Lakes in considerable numbers. Their names are on four of the five Great Lakes and on scores of local rivers and landmarks. French explorers and missionaries reached Georgian Bay five years before the Pilgrims arrived at Plymouth Harbor, and Sault Ste. Marie antedates Philadelphia. French-Indian Voyageurs in the lucrative fur trade sang their canoe songs over the area for over a hundred years before the English conquest of Canada and the Lakes. Today a high marble shaft rises up out of Put-in-Bay, Lake Erie, a memorial to the last armed conflict a century and a quarter ago, between the two nations who since have lived peaceably on opposite sides of the lakes. Literally scores of thousands of early settlers came to Michigan and regions to the west by way of the Lakes. In Mid-19th Century when bulk freight in farm produce, forest products, and

THE PICTURED ROCKS NEAR MUNISING, MICH.

THE CARILLON TOWER ON THE MICHIGAN CAMPUS

copper and iron ores came on with a rush, sailing vessels were built to carry it; and before the appearance of the modern bulk-carrying freighter in the 1890's about 1800 schooners, brigintines, barquentines and other types of wind ships carried the commerce of the Lakes. They were manned by a devil-may-care, chanty-singing

generation of sailors whose stories and songs narrating their triumphs and tragedies still linger about the Lake ports. The beginning of the present century practically marked the end of the sailing vessels on the Lakes. A large portion of them were lost in service and were not replaced, and their bones still rest on the Lake bottoms. There are few areas of any size over the whole Lake surface and fewer reefs and other danger points that do not have their stories of local disaster or rescue.

Scheduled excursion cruises in passenger liners from a few days to two weeks duration will provide the summer visitor to Michigan a memorable outing. He will see the never ending parade of shipping. He will see numerous pleasure craft, oil tankers, self-unloading gravel and crushed-stone carriers, package freighters, possibly some European tramp steamers, possibly the new Pere Marquette Line stream-lined car ferry *City of Midland,* plying Lake Michigan and capable of carrying 34 loaded railway cars, 50 automobiles, and 376 passengers, or he may see other members of the four fleets of "car barns." He may see the 550-foot side-wheel passenger liner *Greater Buffalo* or her sister ship the *Greater Detroit.* He will see scores of the big steel 15,000-ton ore-carrying freighters that this season are expected to transport about 70,000,000 tons of iron ore from Lake Superior to Lake Erie ports. He may visit the Great Lakes Engineering Works at River Rouge where the keels of two new 640-foot freighters, larger than anything now on the Lakes, are to be laid in June. When completed they will each have a carrying capacity of 18,000 tons on a 23-foot, 10-inch draft.

His cruise may take him to Buffalo only a half hour's motor ride from the great cataract of Niagara, or he may go through the New Welland ship canal, one of the world's wonders of canal and lock construction.

He may journey to Lake Superior through the locks of Saint Mary's Falls Canal over which is transported each navigation season much more freight than goes through the Panama and Suez Canals combined.

Should his vessel touch at the Canadian port of Fort William and Port Arthur, he will en route skirt rugged Isle Royale which has recently been converted into a National Park, and he will round the point of Thunder Cape which rises 1300 feet directly out of the Lake. Upon the top of this rock was the home of the great legendary Algonquin Thunder Bird who controlled the fate of the Ojibway nation.

His boat may take him through the Straits between the two peninsulas of Michigan, past the beautiful Mackinac (pronounced

"-aw") Island, famous in story and song, and he may sail into Lake Michigan past the Beaver Islands where Jesse Strang about a century ago had himself crowned as king and ruled over the Mormon colony that lived there at the time. Wherever his cruise may take him on the Lakes he will have a memorable trip, and insurance rates against torpedo and bombing attacks will not be overburdensome.

The University of Michigan most cordially invites the members of the S. P. E. E. and their families to be its guests during the 1941 national meeting, and it hopes that the educational and recreational facilities of the surrounding country will be enjoyed.

A STUDY OF REQUIREMENTS FOR GRADUATION BEYOND ORDINARY PASSING GRADES

By C. A. KOEPKE

Administrative Assistant, University of Minnesota

This report is based on a study of grade requirements for gradution from a number of engineering colleges in the United States. Letters were sent to the deans of forty colleges and at the time this report (May 1, 1940) is written, all but one have replied. The interest expressed in the letters was so thorough and so spontaneous that it was thought desirable to present the study, not only to the contributing deans, but to any other interested persons.

Many of the letters were quite detailed and some sent printed material and booklets to illustrate their methods. Many of the deans pointed out weak points which have shown up in the actual operation of their plans. One cryptically stated that the only excuse for such plans was to do what engineering faculties as a body would not do, *i.e.*, make all passing grades harder to get.

Even though suggestions for possible changes and improvements were quite common, most of these were for the purpose of making the plans work better in their avowed intention of raising the quality of engineering graduates. Moreover, a number of schools also have raised or are considering raising the quality of engineering *students* by applying a quality requirement at stated points before graduation. Although the various plans are being changed from time to time, no dean stated that any action was being considered to abandon such schemes.

Only three universities did not have higher requirements than a passing grade for graduation when the study was made. One of these is considering the possible adoption of a plan. The second one selects its freshmen from the upper forty per cent of the high school classes and thus finds it has a capable group to work with. The third one, Minnesota, has been selecting its engineering students from the upper sixty per cent of the high school classes, but still too many low ability students have been admitted under this plan. For this reason, a committee was appointed to study the possible adoption of a plan to require higher than passing grades for graduation.

From the original forty-one schools, including Minnesota, thirty-eight now have a variety of systems which can be reviewed best by means of several tables. Table 1 lists the schools in alphabetical

TABLE 1

GRADE REQUIREMENTS IN OTHER UNIVERSITIES

School	Is Plan Applied at Other Stated Points Besides Graduation?	Does Faculty Have Tendency to Raise the Grade of Low Ability Students?	Has Your Plan Had Any Effect on Your Engineering Enrollment?	How Long Has Plan Been in Effect?	Plan in Brief
Arizona Univ.		No	No	Long time	28 cr. of D allowed to graduate. Practically a C av. Actually require 80% of all work to be above C level.
California Univ.	End of each semester	Yes	Eliminates the incapable		C average. Applied at each semester.
Clemson College	Yes	No	No	Long time	50% C or above. C in Physics and Math to go on.
Colorado Univ.		No	No	5 years	C average.
Columbia Univ.	At all points after several C's	No	Yes Reduced it		After C grades man is placed on probation. Must obtain B average or be dropped.
Delaware Univ.	End of Soph. 60% C aver.	No	2% are caught as seniors	Over 12 yrs.	C average.
Idaho Univ.		No		Many years	C average. Recently has been raised.
Illinois Univ.		No	No	Many years	C average.
Iowa State College				2 years	C average.
Iowa Univ.					C average.
Kansas State College		No	No	Long time	C average.
Kansas Univ.		No		Many years	C grade or better in 75% of total. D grade Allowed in 35 out of 140 hours.
Kentucky Univ.					C average.
Maine Univ.	No				105 hours out of 143 must have C grade or above. In addition Compr. exam at end of Sophomore year.

TABLE 1—*Continued*

		Does Faculty	Has Your		

Maine Univ.	No				105 hours out of 143 must have C grade or above. In addition Compr. exam at end of Sophomore year.

TABLE 1—*Continued*

School	Is Plan Applied at Other Stated Points Besides Graduation?	Does Faculty Have Tendency to Raise the Grade of Low Ability Students?	Has Your Plan Had Any Effect on Your Engineering Enrollment?	How Long Has Plan Been in Effect?	Plan in Brief
Mass. Inst. of Tech.		No	No	Many years	Must have grade of 2.50 when passing mark is 2.00.
Michigan Univ.	Yes at each semester	No	No	Long time	C average.
Minnesota Univ.	End of each year			First year	0.75 end of 1st yr.; 0.88 end of 2nd yr.; 1.00 end of 3rd yr.; maintain a C aver. in all subjects taken after 3rd yr.
Missouri Univ.		No	No	Long time	No trans. cr. count in C aver. System works well.
Montana State College	End of 2nd year. C av. in 100 cr.	No	No	25 years	Must have 100 crs. and 120 grade points by end of 2nd yr. C+ average.
Nebraska Univ.		No	No	Long time	Not more than 20% of total in the sixties.
New York Univ.		No	No	Many years	D is 60 to 70. An aver. of 70 is necessary for graduation. Ten points higher than passing.
Northwestern Tech. Inst.					C aver. Not more than $\frac{1}{3}$ may be of D grade.
Ohio State Univ.	Informal at end of Fresh. yr.	Generally no	No	18 years	1.8 required (C is 2.00).
Oklahoma A. & M.		No	Lowered somewhat	3 years	C av. based on *all* credits taken and grades received.
Oregon State College	Yes	Probably for hard working poor student	No	Several years	C aver. Also C aver. for entire Senior year. Considering C aver. for entrance to Junior year.

TABLE 1—*Continued*

School	Is Plan Applied at Other Stated Points Besides Graduation?	Does Faculty Have Tendency to Raise the Grade of Low Ability Students?	Has Your Plan Had Any Effect on Your Engineering Enrollment?	How Long Has Plan Been in Effect?	Plan in Brief
Pa. State College	End of every semester	No	No	Long time	C average.
Pittsburgh Univ.		No	No	12 years	Does not favor qual. crs. Says C av. would do everything needed to raise standards.
Purdue Univ.		No	No	Many years	90 hours of B or better out of 140.
Rutgers Univ.				2 years	C average.
So. Calif. Univ.		No	No	Many years	C average.
Stanford Univ.		No		Many years	C average.
Tennessee Univ.					C average. Phy. Ed. and Mil. Sci. not counted.
Texas A. & M.		No			C average with additional idea that all major courses must have a C average.
Texas Univ.	Yes end of Soph. year	No	Has raised it	4 years	C aver. required at end of Soph. year. C aver. required for 140 sem. crs. to graduate.
Wash. State College		No	No	Long time	C aver. Additional requirement that a C average be obtained in major courses.
Washington, Univ. of	Yes each quarter	No	Reduced it slightly	Many years	Mil., Phy. Ed., Naval Sc. not counted. C av. req. to become soph. C av. for graduation.
West Va. Univ.	At all points	No		Few years	C aver. at all times. No transfer honor points counted.
Wisconsin Univ.		No			C average.

order and attempts to state briefly how their plans operate. In certain letters, some of the questions were answered by implication, and we hope we have interpreted them properly.

Table 2 broadly classifies the plans according to the requirements for graduation. A "C" average, which generally is taken to mean one full grade above the lowest passing mark, is the most common requirement. Sometimes only the technical courses are included in the calculated "C" average, which usually has the tendency to make the requirement more rigid. Other schools exclude only military and physical education courses in calculating the "C" average. Regardless of these more or less minor differences, Table 2 lists

TABLE 2

SHOWING NUMBER OF INSTITUTIONS IN EACH GROUP INCLUDING MINNESOTA
Minnesota's Group Figure is Shown Underscored

Plain C Aver.	Between C & D	Above C Aver.	Certain Number of Hours with Grade Above C	Passing Grade Only	Total
26	9	2	1	2	40

this family of plans under "Plain C Average." Likewise, minor differences occur in the group of nine schools which are listed under "Between a C and a D." One school requires ninety hours of "B" out of a total of 147 hours for graduation. The grade of "B" at this school is somewhere between the "C" and "B" grades at most institutions. This plan has many points in its favor but it might be difficult to apply at several points before graduation.

TABLE 3

SHOWING AT WHAT POINTS IN THE CURRICULUM THE PLAN IS EXERCISED
Minnesota's Group Figure is Shown Underscored

End of Every Quarter or Semester	End of Every Year	End of Freshman Year	End of Sophomore Year	At Graduation	Total
5	1	1	5	26	38

Table 3 shows at what points in the curriculum the different plans are exercised. Five schools check their honor point averages at the end of every quarter or semester, five check at the end of their sophomore year, while only one school checks at the end of the freshman year. Twenty-six of the thirty-eight schools check the students' honor point averages only at the time of graduation.

Table 4 shows a tabulation of the answers of other questions of interest. Not all letters were complete and this accounts for the discrepancy in the total numbers. Twenty-eight schools definitely stated that scholarship levels have been raised. Some reported their plans had been in operation so long the old reference plane was lost but some of this group felt that scholarship would be lowered if the plan were to be abandoned.

TABLE 4

Number of schools stating scholarship has been raised	Noncommittal about scholarship, or where plan had been used so long reference plane was lost	Does the faculty tend to raise the grades under the plan?		Has engineering enrollment been reduced by plan?		Has engineering enrollment been increased by the plan?
		No	Yes to some degree	No	Yes	
28	10	28	2	19	3	1

Twenty-eight deans also definitely stated there was no recognizable tendency for the faculty to give higher grades than formerly for the same quality of work. Only two schools stated that, to some degree, higher grades than normal were easier to obtain from some of the instructors. One school said the weaker members of the faculty had to be watched to prevent them issuing too many high grades. One dean commented at length on the tendency of some instructors to be more lenient after the "C" average was installed. In substance, his remarks were to the effect that any grade point system tends to put pressure on the faculty, particularly when someone points out that the last low grade might put a student in serious difficulty. This is a necessary evil in any system and he minimized it in his faculty by keeping a cumulative graph of the grading performance of each individual teacher. When such records are presented to a department faculty, no man likes to have others know that his official grades show him to be particularly easy or unbalanced in his distribution of grades over a long period of time. This dean further points out that the difficulty can be largely avoided by common discussion in faculty meetings of the meaning of the various grades. If a "C" is supposed to represent the average performance in a group, then in general over a long period in most courses there should be as many grades below "C" as there are above.

One surprising factor in this group of schools was the fact that nineteen of them reported no decrease in enrollment as a result of the higher scholarship requirements. Conditions vary so much from school to school that discussions of this point would not be

warranted by the facts at hand. Only four reported decreases in enrollment; one school reported having facts which tend to show that enrollment has increased when higher scholarship was required.

Table 5 shows how long the various plans have been in effect. It is interesting to note that twenty schools report they have had some quality plan in operation for over ten years.

TABLE 5

SHOWING HOW LONG THE VARIOUS PLANS HAVE BEEN IN EFFECT

Up to 2 Years	Up to 10 Years	Over 10 Years
4	3	20

As stated previously, Minnesota took a step toward selecting for higher ability in 1932 when the Engineering College refused admittance to the lower forty per cent of the high school classes. Since the University of Minnesota is the only State university, this would have been difficult before the advent of our General College. This college has provided a satisfactory outlet to many of those who have applied to the Engineering College but who were in the lower forty per cent of their high school classes. This restriction alone, however, has not entirely solved our problem and a committee was appointed to study the possibility of adding a performance standard for the upper sixty per cent.

After due deliberation, the committee decided to recommend a modified "C" average which has been unanimously accepted by the Engineering Faculty. We tried to benefit by the experience of others to the fullest extent. Many of the suggestions for improving established plans have been incorporated to make a composite system which looks good at least on paper. We would be foolish to believe the following plan is in its finished form but we are hoping it will provide a good foundation upon which to build something better.

Table 6 shows the recommended plan in tabular form. One of the most frequent suggestions for improvement was to check students at several points before graduation. Checking at several points before graduation time serves two purposes. It eliminates or discourages the low ability or poorly prepared student before he wastes too much time on an impossible goal. It should also relieve excessive teaching loads and overcrowded classrooms. This will allow more instruction to be given to the able students.

Since it is difficult in most schools to define when a student is a sophomore, junior, or senior, it was decided to put the general checking points at the end of stated periods regardless of the class

TABLE 6

RELATIONSHIP BETWEEN HONOR POINTS AND CREDIT HOURS AT VARIOUS POINTS IN THE STUDENT'S HISTORY ASSUMING REGULAR CURRICULUM SCHEDULE

Quarters of Normal Work	Normal Credit Hours		Minimum Honor Credits Which Must Be Earned to Go to Next Year's Work		Quality of Work Necessary in Following Year if Bare Minimum of Honor Credits Are Made in Past Year	Minimum Honor Points Necessary to Go to Next Year's Work
	Accumulative	Per Year	Accumulative	Per Year		
3	45		34			0.75
		54		53	1.00 during 2nd yr.	
6	99		87			0.88
		54		66	1.20 during 3rd yr.	
9	153		153			1.00
		54		54	1.00 during 4th yr.	
	207				All senior work must average C	

standing of the student. In other words, students are checked at the end of each spring quarter regardless of the number of credits earned during the year or whether they are sophomores, juniors, or seniors. The table shows the honor point averages required at the several checking points. At the end of the first spring quarter a student must have an honor point average of 0.75 (C = 1.00). At the end of the second spring quarter the cumulative honor point average for the two years' work must be raised to a minimum of 0.88. Likewise, at the end of the third spring quarter, the honor point average minimum becomes 1.00 and all work taken thereafter must have an average of 1.00 for each succeeding year regardless of how long the student remains in college.

The low requirements of 0.75 for the freshmen and of 0.88 for the sophomores allow the slow starting student to catch up gradually. However, it is assumed the slow starting student in this case is a potentially capable one and is able to do a better grade of work each year until he finally catches up with the cumulative 1.00 average required at the end of the third year in residence.

At first sight, it appears to be rather easy on the freshman student to allow him to return for his second year with an 0.75 average. But, if a student has the minimum of 0.75 honor point average for the normal forty-five quarter credits, he would need to do 1.00 work during his sophomore year to bring his cumulative average for the two years' work up to the minimum of 0.88. Moreover, in his junior year if he starts at the minimum of 0.88 he would

have to do 1.22 work for the normal fifty-four credit load to bring his cumulative average up to 1.00 at the end of the junior year.

Some of the deans stated that the "C" average at their particular schools had caused a peculiar frame of mind in some students. Some of them work rather hard to get somewhat above the "C" average at the first three years and then coast through in their senior year to a bare "C" average. At the University of Minnesota this has been true even though we have had no quality requirement.

It has been said many times at our school that a diploma is assured when a student reaches senior status. In order to combat this tendency, we have set up the requirement that all work after the third spring quarter must average "C" in quality. This will work no hardship on the sincere and honest student who is anxious to get all he can out of his college work. If he has been able to maintain at least a "C" average on all work up to the end of the third spring quarter, he should be able to maintain this average thereafter.

Each student is advised to calculate his own honor point average at the end of each quarter so that he will know exactly where he stands. In fact, the Students' Work Committee will insist that all students calculate their own honor point averages and report to the Committee any time this average falls below the tabular value corresponding to their length of residence. In other words, if a first year student's average falls below 0.75 say at the end of the winter quarter, he must automatically report to the Students' Work Committee to be placed on probation where he will be given special care and attention. This puts the burden on the student to maintain and check his performance, and we hope it will make him cognizant of the work required of him at all points. To thoroughly clarify the method of calculation, sample calculations are included in the student's instruction manual each time he registers. That is, the student is informed every quarter so that at no point will he be able to plead ignorant of the requirements.

In calculating the cumulative honor point average for a student at any given time the honor points of *all* his past work in the College of Engineering and Architecture are first added and this sum is then divided by the sum of all the credits for which final grades have been given during this time. The number of credits published in the normal curriculum is not considered in this calculation. When and if a course, having previously been failed, is finally passed, the positive honor points, if any, are added to the previous negative honor points. In other words, negative honor points can be counterbalanced but never eliminated. All required courses for

which a grade of F has been received must be repeated. If a grade of D has been received, they may be repeated at the option of the student. Elective courses for which a grade of D or F has been received may also be repeated.

Since the effectiveness of a "C" average plan depends somewhat on the method of calculating the honor points, the following table and example are shown to illustrate our method:

CALCULATION OF HONOR POINTS IN THE INSTITUTE OF TECHNOLOGY

Each credit hour with a grade of A = 3 honor points
B = 2
C = 1
D = 0
*E = 0
*I = 0
F = −1

* In calculating honor point averages the grades E and I are not counted, nor are the credits counted for which the grades E and I have been received. E is a condition grade; I is an incomplete grade. Upon completion of further work these grades are changed to final grades.

SAMPLE CALCULATION

Quarter	Subject	Credits	Grades	Honor Points
First Quarter:				
	Drawing 1	3	C	3
	M & M 11, College Algebra	5	B	10
	Chemistry 4	(4)*	E or I	0
	English 4	3	F	−3
Completion:				
	Chemistry 4	4	C	4
Second Quarter:				
	Drawing 2	3	D	0
	M & M 12, Trigonometry	5	C	5
	Chemistry 5	4	D	0
	English 4	3	A	9
	Total	30		28

Cumulative honor point average: 28 ÷ 30 = 0.93

When and if a course, having previously been graded with F, is finally passed, the positive honor points, if any, are added to the previous negative honor points.

In order to have consistent and equitable standards for transfer students from other colleges, the entrance requirement to a particular point of advanced standing in the Engineering College must sat-

isfy the same minimum honor point average required of any other student already at Minnesota. That is, if a student from an outside college is trying to get junior standing, he must have a 0.88 honor point average in the work done in the outside college. Moreover, the work done at the outside college is only used to gain advanced standing. Honor point averages for future promotion or graduation are calculated only from the work actually done at Minnesota.

The committee feels that the present quality requirement is the preliminary step to a more complete plan to be developed in the future. The question of what to do with those who cannot qualify at the several checking points is a serious one. It is not entirely solved when these men are held back until the failed courses are passed or more courses from approved electives are taken to bring up the average honor points.

However, other alternatives can be considered for these low ability men. One is to ruthlessly discard them and brand them as failures. Another is to guide them into the proper terminal courses where their abilities can be fully developed in sub-professional fields which can provide a variety of work satisfactions. The preliminary report of the S. P. E. E. committee which was delivered at the Land Grant College meeting at Washington last November (1939) suggests a general solution to this problem. Our committee is now studying this more difficult problem.

LOOKING BACKWARD *

By BREWTON BERRY

Associate Professor of Sociology, University of Missouri

In the village of Hampton, New Hampshire, in the year 1656, a young woman by the name of Eunice Goody Cole was suspected by her fellow townsfolk of being a witch. She was brought to trial, accused of "having familiarity with the devil," and found guilty. Her sentence, thanks to a charitable judge, was a comparatively light one—ten years in the Boston jail. She served her time, and returned to Hampton. There she spent the remaining years of her unhappy life, bearing as best she could the fears and suspicions of her neighbors. A Christian burial for her was, of course, out of the question. Instead, her body was pierced with a spike, mounted with a horseshoe, and dumped into a roadside grave. Only then could the people of Hampton heave genuine sighs of relief.

Two hundred eighty-two years later, on August 25, 1938, Eunice Goody Cole was again the center of interest in Hampton. Four thousand townspeople and visitors had gathered for the purpose of clearing her good name. It was voted unanimously to restore her to citizenship. Three selectmen publicly burned copies of all records pertaining to her arrest, conviction, and imprisonment. Mrs. Harry Houdini, the guest of honor, said, "The blasting of witchcraft is so important that I have traveled three thousand miles to be present." Dirt from the roadside grave was taken with all proper ritual and buried in the cemetery of the town. A descendant of one of the original accusers was present to add the stamp of his approval to the whole ceremony. Once again the people of Hampton could heave sighs of relief.

Such a change of sentiment is not hard for us nowadays to understand. This is The Great Age of Science. The last hundred years have seen the sciences multiply in number and enlarge their fields. They have fought their way into the schools and colleges, and now threaten to dispossess entirely their arrogant predecessors, philosophy, theology, and the classics. The learned are no longer honored to be called "scholars and gentlemen"—they all want to be known as "scientists," even the philosophers. As for the man-

* Presented at a meeting of the Missouri Section, S. P. E. E., April, 1940.

on-the-street, he never doubts for a moment that science speaks with authority and finality. Quite naturally, then, we assume that the ancient superstitions are on the way out. And while we recognize the fact that astrology, palmistry, and other mediæval humbugs still survive among carnival fakers, Hollywood's movie stars, and the neurotic women of our large cities, we are nevertheless confident that science has won the battle, and that it only remains for the clean-up squads to clear the field. Such is the faith of a great many people nowadays. To describe our era we readily adopt such labels as "The Century of Progress," "The March of Civilization," "The Age of Science," without the slightest doubt that they are entirely appropriate.

Most of us have seen with our own eyes, and in a single generation, the arrival of the automobile, the radio, moving pictures, talkies, television, and aeroplanes. Go back two generations and we see the birth of telephones, typewriters, electric lights, fountain pens, phonographs, and basketball. And one has only to scratch the surface of history to see that many another commonplace in our lives is but a recent addition to our culture. A century ago our ancestors were without matches, obtaining their fire by striking flint, or borrowing it from their neighbors, after the fashion of primitive people everywhere. Forks, China plates, coffee, tea, sugar, potatoes, rubber, and hundreds of other everyday articles—these have all come to us within comparatively recent times.

It is well for us to bear in mind that man has not always been the eager, progressive creature that we commonly picture him as being. Sometimes he grasps a new invention or discovery with faith, hope, and charity. More often, however, human beings look upon new gadgets with fear, distrust, and suspicion. Bathtubs raised many a problem in the minds of the thoughtful. Good Christians could see no particular objections to them, so long as they were used solely for purposes of cleanliness and health, but they were mortally afraid that some of their weaker brethren would begin using them just for the fun of it, with dire consequences to their souls. One saint concluded that sick people should be allowed to take baths as often as they wished, but all others, and especially children, should be advised to indulge very rarely. Far-sighted laymen expressed the fear that the bathing habit, should it become general, would bring serious questions of the water supply. A book of etiquette, published in 1640, advised taking an occasional bath, washing the hands every day, and the face "almost as often." A similar book, in 1782, laid down this rule, "For cleanliness wipe your face every morning with a white linen. . . . It is not so good to wash it with water, for that makes the face

more sensitive to cold in the winter, and to sunburn in the summer." We can understand with what propriety the elegant Marguerite of Navarre could write as follows to her lover: "Behold these beautiful hands; though I have not cleaned them for a week, I wager they eclipse yours." Yes, the modern bathroom had to fight its way into our civilized lives over mountains of indifference and prejudice.

Other innovations have fared no better. About seventy years ago the following editorial appeared in a Boston newspaper:

> A man about 46 years of age, who gives his name as Joshua Coppersmith, has been arrested in New York for attempting to extort funds from ignorant and superstitious people by exhibiting a device which he claims will convey the human voice over wires so that it will be heard by the listener at the other end. He calls the instrument a telephone, which is obviously intended to imitate the word telegraph, to win the confidence of those who know of the success of the latter instrument without understanding the principles on which it is based. Well-informed people know that it is impossible to transmit the human voice over wires—wires, mind you—as may be done with the dots and dashes of the Morse code, and that, even were it possible to do so, the thing would have no practical value. The authorities who apprehended the criminal are to be congratulated and it is hoped that his punishment will be prompt and fitting, and that it may serve as an example to other conscienceless schemers who enrich themselves at the expense of their fellow men.

Such obstinacy on man's part has been ridiculed by Edgar Lee Masters in his "Spoon River Anthology," in these words:

> Stranger, I saw electric lights come to Spoon River
> Without a protest;
> But when I inaugurated kerosene lamps for the streets,
> You opposed me,
> Saying it was an interference with the divine plan,
> Which had ordained darkness for the night,
> And that lighted streets would cause people
> To remain out late,
> Producing rheumatism and immorality,
> And that thieves would be emboldened,
> And horses frightened.
> You were wrong about all these things,
> But you never learn anything.
> You are still obstructing
> The lighting of streets of thought and life
> With your ideas about the divine plan,
> And your ideas about morals.

History, anthropology, and archæology bear out these facts: the role of the pioneer is seldom an easy one; inventors are looked upon as a queer, dangerous lot; and innovations are usually met with

formidable opposition or distressing indifference. The new is occasionally accepted with eagerness, more often is rejected, and most often is adopted amidst loud cries of protest and warning.

This caution or conservatism on man's part, however, is not entirely to his discredit. A new feature coming into a culture does not involve the simple process of addition. It does not mean that there is merely one more thing to learn to use, one more want to strive for. Nor does it mean that there is but a new way to perform an old task. When the American Indian acquired the rifle from the white man, the important thing was not that he would thenceforth shoot with gun instead of bow, that he would carry on his hunting a little more efficiently, and his wars a little more destructively. It did mean all of these, but more significant was the fact that the rifle forever made the Indian the virtual slave of the white man. The Indian was not a mechanic, he had had no experience with iron, he could not repair his firearms, and he could not produce gunpowder. Early in the 1600's we find Indians sending petitions to friendly colonies asking that smiths be dispatched to reside in their villages. They could lay in stores of ammunition, but when they went to war with the whites, it was inevitable that they would sooner or later have to come to unfavorable terms with them.

Anthropologists have noted, also, how completely the life of the Plains Indians was altered by the introduction of the horse. Before 1650 our great western plains supported only a very sparse population. On its margins there were settlements, built upon an economy of agriculture and hunting. But the hunting did not habitually include the buffalo, for that big animal was almost too much for a pedestrian with his bow and arrow. The horse, therefore, did not mean simply the addition of a means of transportation—it altered the whole social structure. Agriculture disappeared, sedentary life gave way to the nomadic, mobility led to warfare, and a whole new civilization developed around the nucleus of the buffalo, which became the basis of their economic, artistic, political and religious life.

We find similar instances in our own history. Take, for example, the bicycle. For a long time it was only professional gymnasts who had the skill and the courage to mount the high perch atop a wheel and take a turn around the block. But in the 1880's, with the invention of the low "safety" bicycle, the fad swept the country. In 1893 a million bicycles were in use in this nation, and in 1895 half-a-million new ones were manufactured. A special frame was invented for the convenience of the ladies, which won them over; and one ingenious inventor produced a folding screen, which, he declared, would "protect the feet and ankles from view when mounting and riding." Arbiters of style and etiquette de-

cided that not only skirts of walking length, but even bloomers, might be worn without offense to feminine dignity and modesty. Frances E. Willard, the great prohibitionist, fell for the new sport, and became not only an enthusiastic bicyclist, but the author of a popular book, entitled, "How I Learned to Ride the Bicycle." Physicians announced that the therapeutic benefits to be derived from it were incomparable. In 1900 an expert in the census bureau said, "It is safe to say that few articles ever used by man have created so great a revolution in social conditions." He was not without his reasons. The bicycle was taking people to and from work, aiding physicians and mail carriers in their duties, providing new forms of recreation, and greatly promoting legislation for improved highways.

Sociologists have often commented upon the fact that tangible, material inventions produce revolutionary effects upon our intangible, nonmaterial customs, beliefs, and institutions. They have seen how, in the past, automobiles, moving pictures, and other machines, have radically affected family, religion, and recreation patterns; and even now they are beginning to speculate upon the possible social effects of certain new inventions—plastics, mechanical cotton pickers, and trailers.

Man, accordingly, is conservative when he looks upon new and strange devices. And while we may often with justice denounce him as reactionary, dull, stupid, and inert, perhaps it is wisdom on Nature's part that has made him so.

Thus far we have been thinking chiefly about the changes that have come over man's material existence. These are the changes that we most readily think of when we contrast our century with earlier ones. It is these that we use as evidence of the fact that we have been making phenomenal progress. It is these that convince us that we are superior to the unfortunate heathen who do not possess bathtubs, radio, printing, and machinery. It is these, that we can count, and reduce to statistical tables, and use as proof that one state is more backward than another, or that one section of the country is economic problem number this or that. It is these tangible inventions of the past century that we take greatest pride in, that we display at our fairs and exhibitions, and whose creators we delight to honor as our heroes.

But let us turn from these visible, tangible articles, and call attention to the fact that in the past century there has been an equally profound revolution in man's mental life—in his attitudes, thoughts, and viewpoints, especially with regard to his own self, his place in nature and in time, his relations to other men, his conception of his own capacities, achievements, and destiny.

It is well nigh incredible for us in this twentieth century to believe that many of our current superstitions were seriously entertained by learned men a few generations ago. It comes as a surprise, for instance, to learn that in 1840 phrenology was an eminently respectable science, taught in a number of American universities, supported by scholars, scientists, and educators throughout this country and Europe. When Dr. Spurzheim, the European phrenologist, came to America in 1832, the *Boston Medical Journal* said, "We believe that his efforts will form among us a new era in education, and open, in the minds of the most intelligent, new and correct views of their moral and intellectual powers." Before the year was over Dr. Spurzheim came to an untimely death in the city of Boston. Great was the sorrow in that hub of the universe. The funeral committee included Josiah Quincy, President of Harvard, and many another bigwig. The Boston Medical Association attended in a body, and Dr. Charles Follen, of Harvard, delivered the funeral oration. The *American Medical Journal* voiced the sentiments of many an intellectual when it said, "The prophet is gone, but his mantle is upon us."

What I have said about phrenology could be duplicated for many other firmly planted faiths of our predecessors. Astrology, demonology, witchcraft, physiognomy, numerology—these have all had the support of the best intellects of earlier times, and we need not go far back into history to find them stoutly defended. We do not have to be reminded how viewpoints have changed with respect to the antiquity of man, his early development, his place in the animal kingdom, and the beginnings of his civilization. Harry Elmer Barnes has expressed it thus:

> A century ago our society was based upon a geocentric dogmatism, which represented our planet as God's chief creative achievement, and man as the supreme product of divine ingenuity and the main object of God's solicitude. Earth, man and all organic life were looked upon as having been created some six thousand years ago in the brief span of six days, and absolute proof of this fact was supposed to be embodied in an infallible and directly inspired holy work. The final, perfect and comprehensive guide to conduct was to be found in a few precepts contained in this work, and man was believed to be perfectly free to choose whether he would follow these divinely originated and inspired dicta, or wilfully and perversely succumb to the wily seductions of the devil. . . . At the present time practically all of these foundations of the old order have been either seriously challenged or entirely destroyed.

Whether this represents progress or retrogression we cannot objectively demonstrate, any more than we can prove that the material inventions of the past century are synonymous with the social welfare. The fact is, however, that we have undergone a revolution

in our thoughts that is comparable to the revolution that has taken place in our physical environment.

Many sciences have been responsible for these changes in man's viewpoint, but we commonly give first place to geology and biology and their theory of evolution. Theology, certainly, considered this doctrine its major foe and directed its fiercest attacks upon it. The pioneers in anthropology and sociology were not only profoundly affected by the theory of evolution, but for a long time were actually dominated by it. Evolution has made man revise his estimate of his own antiquity, and has made him think of himself as primate and mammal rather than as a slightly soiled angel. Best sellers today do not bear such titles as "The Fall of Man," but, rather, "Up from the Ape," "The Master of Destiny," "The Long Road," "Man Makes Himself," and "The Coming of Man."

What is usually overlooked, however, is the fact that *archæology* has contributed almost as much to this revolution in man's thinking as have the physical and biological sciences.

The conventional belief is that archæology is a dusty and dreary subject, motivated by nothing more than a curiosity about ancient and inconsequential matters. Archæologists, so many a person supposes, are queer creatures who waste their time prying into the past, when they could better be devoting their energies to the practical problems of the present. They are forever looking backward, when all sensible people nowadays are looking forward. We tolerate archæology as a harmless diversion, as something suitable for psychopathic individuals who would otherwise wind up in an institution and become a burden to the taxpayer. It is my contention, on the contrary, that archæology belongs with biology and geology, as a major factor in changing the outlook of intelligent people and in giving man a new appreciation of how he has come to his present state. Just as the engineers and inventors have altered the material life of man, so have geology, biology and archæology altered his mental life.

Man has always wondered about the very problems with which archæology deals. The Book of Genesis testifies to the fact that centuries ago people were asking questions about the beginnings of this thing and that, and their cleverest minds were trying to answer them by elaborating the myths and legends which not a few people today still accept as satisfactory. Greeks, Romans, Egyptians, and Babylonians, as well as the ancient Hebrews, sought, through their folklore, to answer these universal and persistent questions of the human mind. And ethnologists, living among primitive people, have discovered that they, too, invariably possess myths that explain to their satisfaction how their tools, beliefs, customs, and in-

stitutions came to be. Invariably folklore resorts to some divine Prometheus, or to a great man, a Moses or a Hiawatha, as the source of every feature of a culture.

The materials with which the archæologist seeks to answer these questions—the things that prehistoric man left behind him—are found everywhere, and they have been observed and collected by people long before their scientific value and significance were appreciated. Western Europe abounds in huge rock structures known as dolmens, and these did not escape the notice and speculation of our ancient and mediæval ancestors. They were variously designated as fairy rocks, devils' seats, giants' tombs, Arthur's bed, or Roland's chair. The long rows of standing stones found in Brittany were thought to be the petrified remains of Roman soldiers, or some such fanciful interpretation. The British, whenever they could not explain anything, could always resort to the Druids, just as in this country, when some prehistoric remain baffled our forefathers, they could blame it on the Mound Builders. The fact that they knew less about these mysterious people than they did about the object on which they were looking did not invalidate such explanations. The tools of prehistoric man were found on the surface, but instead of using them to delve into the secrets of man's past, they were used to cure the ague or rheumatism, were carried for luck, or were placed in watering troughs of cattle to guard them against diseases.

It was in the second quarter of the nineteenth century that modern scientific archæology was born. Patient, careful digging into caves, village sites, cemeteries, shell heaps, and refuse pits began to yield information with which a new and amazing picture of humanity's past could be drawn. Most of the work has been done in Europe. The Americas are just beginning to receive some attention, and most of Asia and Africa have not yet been scratched. Nevertheless, the outline of man's prehistory has begun to take form, although there is many a gap that needs to be filled, and perhaps there will be changes to make in the outline as additional evidence is gathered.

We see, emerging on this planet more than half a million years ago, a big-brained primate, denuded of practically all of those things that other animals have been provided with for their existence. This animal competed with other creatures, doubtless using clubs and stones, communicating with his fellows in a rudimentary language. It did not dawn upon him that he could deliberately shape the stone that he carried in his hand. It was hundreds of thousands of years later that he discovered that a certain type of stone could be chipped and provided with a sharp cutting edge

or a piercing point. With this skill he was able to manufacture an almond-shaped tool, which, for fifty thousand years, was the prinicipal item of his material equipment. Then he learned to use the flakes from the flint, making crude knives, scrapers, and perhaps points for his spears. He tamed fire, and began to put it to his use. Religious ideas dawned upon him, and he took pains to bury his dead. Then he found that bone had its uses, and he learned to manufacture awls, harpoons, needles, and fishhooks. His esthetic nature began to manifest itself, and he decorated the walls of his caves with drawings hardly inferior to many of the products of our modern master artists. Throughout this long period, known as the Palæolithic, man was a nomad, a hunter and collector of food, his social life restricted to small, hostile bands.

And then, about ten thousand years ago, there occurred the first great revolution in man's existence. He became a producer, rather than a hunter, of food. He domesticated, first the dog, and later cattle, swine, sheep, and goats. He developed the art of agriculture. He settled in villages, and learned to build substantial homes. He invented pottery, learned to weave baskets, nets, and mats, and acquired the art of polishing his stone tools. His communities increased in size and stability, which doubtless necessitated his perfecting systems of government and social control. Europe and the Near East became spotted with many small, self-sufficient, agricultural communities.

And then, about four thousand years ago, a second revolution occurred, brought on by the discovery of metal. First copper, then bronze, and then, about 1500 B.C., iron. This discovery did not mean that man would merely use a metal tool where he had heretofore used stone; but, instead, a complete change was brought into his life. Metals called for prospectors, miners, smiths, traders, explorers—in short, specialization and division of labor, which, up to this time, had hardly gone beyond that of the sexes. The small, independent, self-sufficient communities of Neolithic times gave way to cities, states, and empires. Ships and architecture made their appearance, horses and wheeled vehicles, swords and chariots. Empires and city states, moreover, demanded more than man's memory for a notebook and ledger, and we find coming upon the scene numerical systems, mathematics, scribes, and written languages.

And when this interesting point is reached, achæology turns over to history the task of telling man's story.

This sketch of human prehistory is familiar to every literate person nowadays. We forget, however, that it is a product of a hundred years of archæology, and that it is partially responsible for the radically new viewpoint that characterizes our era. And

this new intellectual environment is every bit as significant as the new physical environment for which engineering is responsible.

Moreover, man's dignity is enhanced, and not destroyed. For when we see man through the eyes of the archæologist, starting from scratch, and struggling through a million years of history, we see him, no longer the pampered child of mythology, the passive recipient of favors bestowed upon him by indulgent demigods, but, rather, as a patient, ingenious, persevering artisan. If he is not the master of his fate, he at least insists that he can whittle out a considerable portion of it.

We see him, moreover, not as a rugged individualist, carving out his own career with his own hands, but as a social being, relying upon the accumulated knowledge of all of his predecessors, and upon the discoveries of his fellow men in remote corners of the earth.

And we see him searching, not for absolute, final answers to the problems of life, but as continually and repeatedly adjusting himself to life's problems as they arise, discarding those adjustments which cease to function, and seeking for new ones as new situations arise.

This viewpoint prompts us to become tolerant of man's differences, charitable toward his shortcomings, proud of his achievements, and hopeful of his future.

THE CHANGING FIELD OF EMPLOYMENT AND POSSIBLE IMPLICATIONS FOR CURRICULUM ADJUSTMENT *

By H. LOREN THOMPSON

Instructor of Civil Engineering, University of Idaho

We are all familiar with the ever-present criticism of our engineering curricula—they are becoming too specialized. Many such criticisms follow that given by Dean G. M. Butler of the University of Arizona in the December, 1936, JOURNAL OF ENGINEERING EDUCATION. This criticism reads, ". . . most engineering curricula are still open to the indictment that they are altogether too technical and deplorably narrow and they give the students too little time for desirable extracurricular activities." Criticism as this and such efforts as those of Dr. D. B. Steinman and a small group of engineers within the National Society of Professional Engineers are definitely healthy signs of a stable organization.

Engineering education operates under changing conditions and is always challenged by industry which absorbs its product. The first course in engineering was given over one hundred years ago. In those days certain professions were established such as medicine which probably had the highest rating of that day. Since at that time it took four years to complete a course in medicine, it was natural that engineering education be established on the same basis. Having established the length of course the decision as to the subject matter to be taught must have been a difficult one. It is no wonder that blacksmithing, carpentry, and other such courses were required under some such names as forge and wood shop. No doubt it was quite a task in those days to think of enough courses of pure engineering nature to fill out a four-year curriculum.

However, with each passing year it became necessary to add to the pure technical content of the work being given. This has been accomplished by dropping courses that could be dispensed with. There still may be opportunity and necessity for the further addition of technical material as well as courses in the "Humanities." The four-year course as it stands today is no more unbalanced than it ever was. On the contrary, I believe that we are providing the

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student with fundamental technical courses that fit him to work for the benefit of our industries and specialized professions. This does not mean we are to be satisfied with our past or present effort toward striving to give our students what they need so that at the end of four or five years they can confidently go out and take their place in the business world. Since engineering is a changing field, it will take constant effort each year on the part of engineering educators to adapt their teaching to a changing business world.

Every professional man must recognize the changing fields within his own profession if he wants to survive. For instance, the law profession must provide men trained to appear before labor relation boards, and government agencies, to adjust the numerous conflicts of business and government. A lawyer capable of handling this kind of work will have little trouble in finding a practice. The "practice" will find him because the differences between business and government, and labor and business are on the increase as shown by our local papers every day. Some war-boom industries such as airplane manufacturing will increase after switching back to peace-time construction of small planes—maybe, a model "T" airplane. This is going to open up new employment possibilities for those who are trained. There are other fast-growing employment possibilities that could be mentioned before going to the field of civil engineering. Some are the ceramic industry and statistical work, the latter has increased the number of statisticians by fifty per cent in three years. Wider uses are being found for cement, tile, and glass and there are supposedly only 1500 ceramic engineers —specialists in this field.

To those who are trained for these ever-expanding industries, will go the "spoils." However, there are some fields that can only absorb a limited number of men. For instance there are only 1200 commercial airline flying jobs in the United States, and this particular field can absorb only a very limited number of men. The fascinating field "news reporting" seems to be a closed field as some 7000 to 8000 graduates of our liberal arts and journalism schools find when they seek to "break in" the big city dailies which actually draw on their small town publishers for less than 100 reporters and writers per year.

These examples from outside civil engineering are brought before you to show that some professions are definitely expanding with considerable opportunity for the young men who are graduating from our colleges and universities. In other fields the competition is getting so keen that very few can forge a place for themselves. As educators, the society is interested in education and vocational guidance and when we are asked what this or that field offers we can honestly answer the inquirer.

It has been reported that the engineering colleges of the United States last fall had a general increase of freshman students of thirty-five per cent. This is a tremendous increase considering the large number of men we are graduating now. Such an increase is going to swell our graduates by about the same percentage three years hence. Our placement problem is complicated as it is but with this increase of students, our problem is going to be doubled as a real effort will have to be put forth to place this additional group. If we have a class of 100 graduates, the first fifty may be placed in reasonable positions relatively easy while it takes special effort to place the last man.

With the increase of students it seems that some sections of the country are getting freshmen that are not as well prepared to undertake a stiff technical course as those freshmen a few years ago. This is due, I believe, to over-emphasis, on the part of preparatory school authorities, of various educational theories as to the ultimate purpose of our secondary school system. Too much stress is placed on vocational interests and "training for life" which is good, I'll grant, but is a broad field. Such theories give to the high school curricula too much general or diversified subject matter.

Our position in the field of education is this:—four years of intensive technical training sandwiched between the general and diversified knowledge of the high school students and the constant challenge of industry and the professions of our product—the graduate engineer. Therefore, our problem is two-fold. We must keep the level of entrance to our colleges at a point where secondary school graduates may enter and furnish to industry a product that will be beneficial to them, and thus, a training by which the student can make a living after he leaves the campus. Any adjustment of our curricula should be toward the end product without, of course, neglecting the fact that our supply of material comes from the secondary schools.

A very good picture of the diversity of the field of engineering has been given by the committee of the S. P. E. E. that studied the aims and scope of the engineering curricula. Quoting from their report in the March, 1940, issue of the JOURNAL OF ENGINEERING EDUCATION:

> While the activities of engineers have a common denominator in the engineering method, they are too numerous and varied to fall within any definition of a profession that could be legally defended and applied. These responsibilities include the entire range of technical and executive direction involved in the production of fuels and industrial materials, the planning and erection of structures, the design and fabrication of industrial products, the planning and operation of utility services, the ordering of industrial plants and processes, the sale of technical products

and their adaptation to special uses, and the administration of technical enterprises, both private and public. The education of men for all these activities lies within the responsibility of the engineering college. This is the "Engineering Fraternity."

This diversity in the engineering field is being recognized more every day. The public and universities no longer feel that some fields such as production and sales require a hale-fellow-well-met with a certain amount of iron in his soul but without a great deal of technical or intellectual depth. The depression and unemployment made it necessary for more technical graduates to go into production and sales which is not purely technical work. With a large group to choose from, technical directors placed more and more emphasis on personal qualities. Students observed that the few jobs that were available went to the men with technical training and to those who were active in extra-curricular activities which developed their personality and ability to meet people. This increased the students in engineering who were active in fraternities, sports, and publications. Sales and production executives were quick to recognize the new type of men available. Soon other branches of business began to place more emphasis on this complementary training.

With the increased complexity of business, industries are turning more and more to engineering graduates to fill junior executive positions feeling that the engineering training is the best possible training for business in general. This is opening new fields for all engineers including civil engineers. With the opening of such fields to our graduates, it places the responsibility on our engineering colleges to furnish this new type of engineer—the one with the technical fundamentals as well as with the "complementary training." Not until we fully recognize the place of this so-called "complementary training" or development of personality along with fundamental technical subjects will we succeed in turning out well-balanced men.

You have all come in contact with the student who stands high scholastically in his class—but you have to stop there. There should be some way to get down underneath his surface and actually help him in his personality problems. Sometimes we talk to such students and discuss the problem slightly or hint at suggested corrections. It would be much better if we could give direct and valuable assistance to students in order that they may develop these "extra" qualities that employers want.

Mr. George R. Beach, Jr., Manager, Personnel Division, E. I. du Pont de Nemours and Company, Inc., in his paper on "Selection of College Graduates by Industry" (delivered before the No-

vember, 1939, meeting of the Association of Land-Grant Colleges and Universities) states the following:

> There is one institution of higher learning in this country that has done more to solve this problem of personal development in its undergraduates than any I have encountered. Our proximity to Annapolis makes our office one of the first places to which prospective young naval graduates, who will not be commissioned because of failure to meet physical standards, turn when they learn that they will not be able to pursue their naval careers. I think I can say almost without exception, that these young men present a better front to the employer than the graduates of any other institution. They are poised, confident, assured, and courteous; they have that attitude of definite purpose which is a prized asset to a man in any walk of life.
>
> Because I have seen this repeated spring after spring, I do not think it is an isolated experience. When you consider the diverse types of personality and the sources from which they come, I think you will agree that the naval authorities are doing an astounding job. They take men from the Kansas plains, the fishing ports of New England, and the ranches of Texas, who represent all shades of economic security and yet when the job is completed each young man lives up to the ideal of the Naval Academy in producing men of whom it can be said that they are officers and gentlemen.

These statements could well be given serious consideration. There may be some ways in which we might emulate the U. S. Naval Academy. This problem may not be solved until the science of psychology has advanced to still higher planes, but we could make more use of what psychologists have already discovered. However, with any study of the value and effects of extra-curricular activities in developing personality, self-support in college should be considered on the same basis.

We have discussed several things that should be considered in any curriculum study toward a possible evolution of one that will meet the needs of both secondary school graduates and future employers better and be more balanced than our present one. However, I have not touched any specific field in civil engineering that may have a particular bearing on the adjustment of the technical matter in our curricula.

The Federal government is one large employer of civil engineers. Engineers appointed under civil service have increased considerably in the past five or six years. This seems likely to continue rather than decrease. From 1936 to the fall of 1939, 1,549 permanent appointments have been made in the P–1 grade (Junior Engineers) and a total above this grade of 841. 785 P–1 appointments were made in 1939. This was two and one-half times the number appointed in any one year since 1928 and almost four times the

average of 202 per year during that period. All of these were not civil engineering graduates but a large percentage, I am sure, were. There were a total of approximately 20,000 engineers working for the Federal government in 1939, of which over 12,000 are under civil service. These figures do not include the large number of sub-professional positions such as draftsman, engineering aide, scientific aide, etc., that were appointed during that period.

Of the various agencies of the Federal government employing civil engineers, the Soil Conservation Service is relatively new. This organization has many distinct civil engineering problems. As a rule their work does not involve heavy construction but they are interested in water facilities for farms and for irrigation purposes, soil erosion, and various other agricultural problems. Since this is a new field considerable experimentation has been carried on to find out the best and most feasible methods to be used in soil conservation. With further study and as new engineering developments come in this field there will be an increased demand for civil engineers who have an understanding and an appreciation of their problems. This may lead to inclusion of additional technical matter covering conservation in the civil engineering curriculum or may be added as an option. Fertile soil is one natural resource that the nation must maintain. With agriculture as one of the basic industries of our nation, everything should be done to maintain and strengthen its position to produce economically. The civil engineer with a knowledge of the farmer's problems in soil conservation will have a definite future in our economic system.

The highway engineer who designs new roads and re-locates or changes the design of existing roads will find his branch of engineering offering many opportunities in the future. Not only must present-day roads constantly be repaired, but new roads must be built. Earlier highways in this country were not designed to carry the tons of freight that are now hauled by trucks. As a result of inadequate design of the past, many roads must be widened, strengthened, or completely re-designed. With modern traffic it is recognized that roads must be made fool-proof. This means that many dangerous curves and slopes must be eliminated. The diversion of state highway funds from road construction to direct relief has created further problems for the highway designer.

Because of poor highway location and design the public is demanding that such mistakes should be rectified and that future designs be more permanent and safer. The tremendous damage caused by frost each winter and spring to "black top" pavements throughout the nation particularly in the northwest is a most serious problem. Much research on asphalt materials as well as soils for

sub-base courses has been done but much remains to be done. Highway courses and highway options in the civil engineering curriculum should stress more the economics of highway construction and location, the value and opportunities of research, the value of traffic studies and safety, and the place of highways in regional, state, and national planning. This is what the public is going to demand more of as time passes.

One of the oldest fields in civil engineering is the construction of buildings, public works, etc. However, there is no field that is and has changed as rapidly as heavy construction. Each year brings new and heavier equipment and new schemes of handling material causing greater technical complications. With the heavier equipment construction costs have been reduced thus making it feasible to construct larger projects. As an example of reduced costs the Public Roads Administration's statistics show that the average unit price bid on excavation in 1938 was 45.7 per cent of that bid in 1923. The average cost of excavation of the All-American Canal was ten cents per cu. yd., whereas twenty years ago the standard price for such work was thirty-five cents per cu. yd.

With such large projects as Hoover Dam, Grand Coulee Dam, Central Valleys Project, and others the economies of plant design to carry on the project becomes of major importance. The actual planning of construction operations with suitable controls and proper coördination between operations is often a major piece of engineering. The modern construction superintendent is quick to realize the value of expert technical advice in the selection of the most economical equipment—which is not a result of snap judgment but of familiarity with the quality as well as output of the equipment.

Not only must the engineer supervise the construction operations but he must make cost control studies. The prime importance of cost control is the reduction in uneconomical operations and keeping account of the actual operating costs as the construction progresses. Control of operation cycles of transportation equipment to obtain the best possible handling of material is part of the construction engineer's work as well as other operations that occur in cycles such as drilling and form handling. A judicious use of such operation data offers many opportunities for improvement. Good judgment combined with a technical knowledge of materials and methods with considerable diplomacy are necessary requirements for engineers doing such work.

With the advent of the Wagner Act and the Labor Relations Board the importance of labor relations to the economics of construction is realized more each day. Shut downs with their delay

in operations and idle equipment cost the contractor many dollars each day. Only by establishing sound and fair relations with labor can construction operations be kept on a productive basis.

Mr. Adolph J. Ackerman, Development Engineer, Dravo Corporation, in his article "Engineering Training for the Construction Field" published in the September, 1939, issue of *Civil Engineering*, states the following in regard to the possible inclusion of more material on construction methods in the civil engineering curricula:

> If an effort were made to develop an engineering course devoted to the field of construction, the following subjects are suggested in addition to those common to the various branches of civil engineering:
>
> Job management
> Bonding and financing
> Estimating and job planning
> Contract law
> Labor relations and laws
> Ethics
> Personnel training and welfare
> safety
> Accounting and cost keeping
> First aid, health, and workman's compensation
> Equipment design
> Measuring equipment performance
> Concrete and aggregate production and handling
> Electric motors, controls, and power production
> Earth and rock handling
>
> It would also be highly desirable to encourage students who are interested in construction to expand their courses and undertake some very practical types of study. For example, a thesis or seminar work could be undertaken on a grade separation or similar moderate-sized public project at the time it is currently being considered. The students could prepare their own estimates, formulate a program of construction, equipment, and labor requirements, and later compare their work with the official bid prices and the execution of the work by the contractor. By such direct comparison they would acquire a good understanding of the contractor's approach to such a problem.

In adopting any such program that Mr. Ackerman suggests we should keep in mind the level at which the graduating engineer enters the construction industry. Many of the subjects suggested would not be of immediate use although valuable. The young graduate will not be given an executive position but must spend several years in the industry before such major responsibilities are his. If in this apprentice period he can better study labor relations, job management, material handling, etc., than in college, then that is the time he should devote to this material. However, there are some subjects suggested that could possibly be studied better while in college such as contract law, bonding and financing, and accounting and cost keeping.

The adjustment of our engineering curricula to these changing fields and conditions is something to weigh with much thought.

We do want to give our students what they need most. Along with any thought of the increase in technical loads the "complementary training" (that of the student's personality) should be given equal consideration. We are too prone to "prune" to scholastic standards when actually very few failures in industry are caused by lack of technical knowledge but rather to an inability to get along or work together with superiors and those who are under them. However, industry does want the very best "brains" available, but in the majority of cases they must be presented in combination with other qualities.

The addition of more technical material with a balance of "Humanities and Social Sciences" along with the complementary training will probably require some day (but the need does not seem a necessity now) a longer undergraduate program. When that day comes we as engineering educators should insist that whatever form it takes (pre-engineering education following graduation from high school or otherwise) that all of the work beyond the high school for the training of engineers be given in the engineering colleges for the proper installation of the "Engineering Methods."

THE VALUE AND NEED OF ORGANIZED EMPLOYEE TRAINING PROGRAMS IN CIVIL ENGINEERING FIELDS *

By HUGH G. CONLEY

Instructor in Civil Engineering, University of Southern California

The general subject of employee training is one which has been accorded a growing amount of attention in recent years. Someone has facetiously defined a specialist as "one who learns more and more about less and less, until finally he knows everything about nothing." Although the specialization is usually not carried to the extreme suggested by this definition, the present era is, certainly, one of specialization. One finds not only specialization of industry, but also increased specialization within the individual industries. This being the case, it naturally follows that these industries should attempt to train their employees to cope with the problems peculiar to their particular duties.

But why, it may be asked, should the graduate of an engineering school, a man who has already received a technical training, be obliged to continue his training after leaving college? Is he not already equipped to deal with the problems which he may encounter in his chosen field? The answer is that he is not! Nor does this mean that the engineering schools are at fault. The best that they can hope to accomplish is to train the student in the fundamental principles of his chosen profession and give him some conception of the application of these principles to the solution of problems which may occur in practice. But during his undergraduate training he has little, if any, opportunity to wrestle with actual engineering problems. The graduate is not yet an engineer!

Realizing this, a number of concerns employing large groups of recent graduates have taken it upon themselves to carry on from the point at which the engineering schools must stop. They have instituted well-organized training programs for these new employees for the purpose of acquainting them with the work of the particular industry. Some of these programs are of only a few months duration; some require one, two, or even three years for completion. Some involve working in different departments of the organization

* Presented at the 48th Annual Meeting of the S. P. E. E., University of California (C. E. Div., Young Men's Forum), June 24–29, 1940.

under close supervision, while some in addition to this involve more or less formal classroom work.

Mr. J. V. L. Morris, in his book "Employee Training," classifies plans for the training of technical men in industry in the following categories:

(1) Provision of both technical instruction and practice.
(2) Coöperative employment of engineering students in industry.
(3) Employment of technical college graduates under supervision for experience and adjustment to positions in the corporation's personnel.

Under the first classification he puts those plans which contemplate the employment of high school graduates, preferably those who have had a technical course, at a small wage. The training consists of working in various departments under close supervision and receiving instruction in technical subjects for one to two hours each day.

The second classification includes those plans which have been inaugurated by a number of engineering schools in coöperation with various industries whereby periods of technical instruction are alternated with periods of practical employment. The student thus receives a certain amount of actual experience in engineering work to supplement his collegiate training before he graduates. The attempt is made, of course, to provide this training in the field which the student hopes to enter.

A study of either or both of these types of training programs would be of great interest, but it is with the last of the three classifications that the present discussion is concerned. Mr. Morris, in his book, gives a general description of this form of training as follows:

"In general this training is on a productive basis. The college men are required to punch the clock with the other workmen and in general obey the rules of the plant. That it really means valuable experience to the young man is probably chiefly dependent on his own initiative and capacity to observe. It is expected that he will gain under these uninterrupted conditions the benefits arising from practical work that have been claimed to accrue from the coöperative plan of college organization.

"Ordinarily there is or should be someone to give sympathetic explanations of the difficulties met with for while the student may be well equipped technically, in manipulative skills he may not be much better off than an unskilled apprentice, for it is to be remembered that a great deal of the specialized equipment of a plant is not and cannot well be duplicated in the school shops.

"In some cases there are regularly scheduled conferences of these young engineers. These provide for an exchange of ideas on practice and offer a convenient opportunity for a superintendent to explain the work of his department by a talk or lecture.

"The courses are quite varied in length . . . those preparing for employment in productive departments and leading to positions in the management are ordinarily the longest. For these two years is a common length of training. In other departments the period which may properly be designated as training is commonly terminated within a year of enrollment. Of course the slower men may serve a longer novitiate. It should be said that the men are under constant scrutiny by the corporation's officials and many are rejected as unsuited to the company's needs."

The foregoing quotation, it is believed, gives a good word-picture of the methods generally followed by a number of concerns in training the recent graduates they employ. In discussing the subject of employee training programs in civil engineering fields it was felt that it would be of interest to discover what was being done along this line in other fields of engineering. With this end in view, a few companies which were considered as being representative in their fields were contacted. Some replied at length, others more briefly, one or two not at all.

Employee Training Programs in Other Engineering Fields

The field of electrical engineering provides some of the best examples of organized employee training programs.

In the electrical manufacturing industry most engineers are familiar, at least in a general way, with the elaborate training programs of such concerns as the General Electric Company and the Westinghouse Electric and Manufacturing Company. The following information has been taken from the booklet, "Training for Leadership in Industry," published by the General Electric Company. In many instances direct quotations have been used.

"Each year the General Electric Company employs a selected group of technically trained men seeking to find their life work in the many branches of its activities. We are desirous that the choice of work by these men will be, as the years progress, a source of satisfaction to them and to the Company. Our constant effort is to clear the road and open opportunities for further education, training, and advancement."

The student engineering course was established early in the 1880's by the founders of the Company. Through the years its program has been broadened, enlarged, and perfected until it "now embodies two kinds of activities. The first is the experience pro-

gram, starting with the Student Engineering Course—or 'TEST' as it is popularly called. There the young men in training are given complete responsibility for the operation and testing of the most important apparatus; they get a practical background in design, and manufacturing methods and materials, gain a sense of the size and proportion of things, and learn to accept responsibility and lead others. . . . The Test Course gives the engineers a valuable background of experience regardless of what type of engineering work they enter. After the Test Course, some of the men leave the Company to go into various industries, public utilities, teaching, banking and many other vocations. The majority, however, continue their experience in actual work, accompanied by education in the various branches of engineering in General Electric.

"The second type of activity is the educational program. Each student engineer—or Test man—is encouraged to take one of the various courses, such as the General Course, the Sales Engineering Course, the Advanced Course in Engineering, etc.

"Throughout this program and continuing in the whole organization, the Company has two basic philosophies: first, to train a man for a responsible position—he should be given real responsibility as early as possible and it should increase continually; second, the Company has no rigid system of titles or organization but molds each job to fit the available individual. In all cases, it is intended that each individual vary his duties as he develops, so that none will find his abilities restricted by the arbitrary confines of an organization chart."

"The General Course offers a broad training in business and in mechanical or electrical engineering, depending upon the students preference, . . . In the Business Division . . . the Test man obtains a working knowledge of the economics of General Electric operation, how the Company is organized, and what opportunities exist for young men in its various departments."

In the Electrical Division, "Test men study the characteristics and uses of various types of electric apparatus under the leadership of experienced practicing engineers. The text material used includes recent developments and is especially prepared for the Course by Company engineers, who present each situation from a practical commercial viewpoint. . . . The Course is divided into three successive sections, studying the Central Station, Industrial, and Transportation fields, respectively."

The Mechanical Engineering Division "is conducted for those who are interested in or are already engaged in mechanical design, engineering, manufacturing, or closely related fields.

"The material covered in the Course is of a practical nature including sections on engineering materials, manufacturing proc-

esses, and topics of general interest to mechanical engineers, such as vibration, lubrication, fluid resistance, and heat transfer."

In order to prepare men for positions in their sales organization, "the Company has established a course in sales engineering for Test men. Selections for the course are made on a competitive basis.

"The program extends over a period of three years, during which time the young engineers do responsible work in the Testing Department, Designing Engineering Department, and General Office Commercial Department. This practical experience also prepares them to handle efficiently engineering problems that will be confronted in sales engineering work.

"The practical experience is supplemented by an organized program of class work which has been developed around the experience of successful sales engineers."

"The Advanced Course in Engineering is conducted to train a selected group of Test men, who excel in analytical ability, to apply basic physical principles to the solution of new and difficult engineering problems. This course is especially helpful to young men who desire to go into the more advanced phases of design or development work, whether mechanical, electrical, or thermal.

"Each September, a small group of Test men is chosen on the basis of an examination, their college records, and interviews. The half day of class each week is devoted to discussion and lectures by staff members and authorities from engineering departments, preparatory to the assignment of a difficult, practical engineering problem to be solved at home. The students obtain training and experience in original and resourceful analysis—sifting actual data, making engineering assumptions, applying mathematics, and obtaining, checking, and interpreting practical results.

"At the completion of the first year, approximately one third of these men—those who have demonstrated their aptitude for even more advanced work—are given the opportunity of continuing with the second and third years of the Course. Most of the others, having successfully completed one year of intensive training, are offered permanent positions in engineering departments to fill the great demand for men with this background.

"The continuing group divides into three sections, studying electrical engineering, thermal engineering and high-frequency phenomena. The first two groups join in the third year in studying mechanical subjects, while the third continues in high-frequency work. During this time, the men spend several months each in various engineering departments, laboratories, shops, and district offices.

"At the completion of the three years, the graduates are given the opportunity of permanent placement in engineering departments."

The educational program sponsored by the Westinghouse Company for their employees is no less elaborate than that of the General Electric Company, and differs from it sufficiently to merit some consideration here. The following information has been taken from the booklet "Educational Opportunities for Westinghouse Employees, Season 1939–40." Once again direct quotations have been used freely.

In addition to the Graduate Student Course conducted by the Westinghouse Company, which will be discussed presently, graduate programs leading to the degrees of Master of Science and Doctor of Philosophy are made available to employees of the Company through the coöperation of the University of Pittsburgh and also New York University, Polytechnic Institute of Brooklyn, and Stevens Institute of Technology. Some of the courses must be taken under the direction of the faculty of these institutions at the regular tuition rate; but a great number are conducted by Westinghouse lecturers and the only fee for these is a registration fee of five dollars for each registration, regardless of the number of courses taken.

Educational opportunities of a more general nature are afforded the Company's employees under the sponsorship of the Westinghouse Club. The activities of this club include special study groups (other than graduate); popular lectures and cultural courses; clubs, exhibits and excursions.

The graduate student course was established by the Company "over fifty years ago."

"Appointments to the Graduate Student Course are normally made after calls of representatives to the various college campuses. Applicants are viewed with the actual needs of the Company in mind and those who have particular desires as to design, manufacturing, research, commercial and other activities are classified accordingly. First assignments in the manufacturing organizations and offices help to verify the correctness of the expressed wishes of the graduate student, and subsequent training is influenced by the reports of both the student and his immediate supervisors in these assignments.

"Assignments in laboratory, manufacturing or office sections are one to two months in length, depending upon their character, and are of a non-process nature. The general plan of schedule involves four to eight months of work in the Pittsburgh district. Later assignments may be at other plants or may continue at East Pittsburgh."

The Course comprises two more or less distinct divisions: the General Training School and the Engineering and Design Schools.

"All graduate students preparing for the activities of the sales, works, accounting and purchasing departments follow the schedule offered in the General Training School. Actual assignments to office or shop departments and classroom conferences are experienced concurrently with classroom work requiring each Friday for a period of seven months or less." This School offers courses in the following subjects: Westinghouse Products; the Company and Its Business; Personality Development; Seminar; Industrial Markets and Application Problems; Works Management; Accounting; Assignment Reports; Westinghouse Orders and Order Service; and Price Forms.

"Engineering and Design Schools serve for the training of those who are to enter engineering and research positions.

"Engineering School provides thorough and intensive instruction in the design and application of all principal apparatus manufactured by the Company. Except for an intensive period of six weeks during which all time is devoted to classroom work and preparation, the graduate students follow parallel assignments in offices and laboratories. The conferences are under the leadership of outstanding design engineers and the important features of the design and correct application of no less than twenty-eight products are discussed.

"Graduate credits under the University of Pittsburgh-Westinghouse Plan are available to those who register and successfully complete the Engineering School program. The first, or six-week intensive portion of the course, provides two graduate credits. The second portion of the course is twelve weeks in length and provides two additional graduate credits.

"Graduate Students segregated for mechanical design activities attend Mechanical Design School after the completion of the first phase of Engineering School. The treatment here is quite mathematical and twenty-four periods are given to the study of each of four fundamental mechanical engineering subjects; namely, Dynamics and Vibrations, Elasticity and Strength of Materials, Applied Mathematics, and Heat Transfer in Electric Machines. Two graduate credits are provided for each of these courses."

"The following courses listed under General Training School are also a part of the Engineering and Design School Programs: The Company and Its Business, Industrial Markets and Application Problems, Personality Development, and Seminar."

Another excellent example of employee training in the field of electrical engineering is to be found in the telephone industry.

Contrary to the popular belief, neither the American Telephone and Telegraph Company nor the Bell Laboratories dictate the policies of the Associated Companies. Each Company formulates its entire program of activities as it deems best, merely paying to these concerns what might be regarded as "retaining fees" in exchange for which each of the Associated Companies is entitled to certain services, such as complete information on new developments in equipment, which it may use or not as it sees fit in the light of local conditions. For this reason it is entirely possible that the hiring and training programs of the Associated Companies may differ from each other, at least to some extent. The plan followed by the Southern California Telephone Company is, however, probably typical.

The employee training program followed by this Company includes, of course, not only its engineering recruits but employees concerned with every phase of its activity. Many of these are given formal classroom training in addition to practical experience under supervision and an investigation of the entire program would make a very interesting study. However, it is the training of engineering graduates which is of particular interest here.

In the spring of each year, when business conditions warrant it, representatives of the Company visit the campi of the various engineering schools and interview students who are about to graduate, selecting those who appear to be best suited for work in the telephone industry.

The course of training provided for these men involves no formal classroom study; but they are given successive assignments to work under supervision in the various departments of the organization in an effort to familiarize them with the various phases of the Company's activity. For instance, a man will be assigned to work for a time with an installation crew, not with the idea of making him an expert telephone installer but to acquaint him with the problems encountered in that work; then he may be assigned to work with a line crew, again not with the idea of making him an expert lineman but to make him familiar with the problems encountered there; and so on. The program includes, of course, rounds of duty in the various offices of the Engineering Department.

The entire program requires about three years for completion. During all of this time the men are under close observation, and before the end of the training period it is possible to determine the particular activity for which each individual is best suited. A few of the men, although it is usually very few, are found unsuited to the needs of the Company and are dismissed. A few others decide that they are not interested in telephone work. But most of them

go on and work up to positions of responsibility in the Company's organization.

One very noteworthy feature of the entire employee training program of this Company is the fact that no employee is required to spend any time on his training for which he is not paid. This is a practice which, it is believed, very few concerns follow but which should do a great deal in the way of improving the "esprit de corps" of the employees.

In the field of mechanical engineering, too, one finds fairly extensive and well organized employee training programs, although it was not possible to obtain as detailed information on these from the companies contacted as was furnished by the several electrical companies. The Ingersoll-Rand Company replied very briefly to a request for information with a statement to the effect that they employed mechanical and mining engineers, that these men started by working with the Company's service engineers in the field for a period of four months, and that they were then taken back to the manufacturing plants where they were given a "thorough course" on the equipment which was manufactured. It is possible that this course is similar to that of the General Electric Company for training electrical and mechanical engineers, which has already been discussed at length, although no information was given as to the nature or duration of the course.

The Oil Well Supply Company, a subsidiary of the United States Steel Corporation and manufacturers of oil field equipment, stated that "Each year several engineering school graduates are employed by us. These men are given several months intensive training at some of our factories before they are sent to the field. Many of these men have become very successful in sales engineering, service engineering and research work." Again, however, no information was given as to the exact nature of this training or the methods employed in giving it.

In petroleum engineering there appears to be little attempt to provide organized training for recent graduates in engineering. The following quotation is from a letter received from the Standard Oil Company of California:

"We do not have an organized training program for technical employees. In each department to which technical employees are assigned, it is customary to have them perform various duties which will enable them to obtain a broad background and gain experience. The extent of such job rotation varies with the nature and extent of operations in different departments."

A somewhat similar scheme of "job rotation" is used by the Shell Oil Company; but there appears to be no definite procedure established. Probably the same is true of the other oil companies.

Employee Training Programs in Civil Engineering Fields

Investigation reveals a deplorable lack of organized employee training programs in civil engineering fields. True, there are to be found a few instances where some attempt is being made along these lines, but they appear to be the exception rather than the rule. One of the best training programs, that of McClintic-Marshall, was largely abandoned, apparently, when the Bethlehem Steel Company took over that company. For the most part governmental agencies, Federal, State, County and City, have done little. There are, however, at least two plans which are worthy of note. One is that of the American Bridge Company, which is described in a letter from them:

"In June of each year (business conditions permitting) the American Bridge Company recruits a class of outstanding civil engineering graduates from the graduating classes of engineering schools. These men are collected at our Ambridge Plant, Ambridge, Pa., where they undergo a four-weeks course of intensified training under an instructor. At the end of this four-weeks course they are distributed among our several drawing rooms, where they continue under close supervision by the Plant Engineers.

"These men are started in at a stated rate per hour (40 hours per week). At the end of six months, five cents an hour is added; in nine months five cents an hour is added; and at the end of a year and a half, ten cents an hour is added. After this time they are on their own as to any further addition in rate.

"The matter of culling-out these men begins during the four-weeks course, and proceeds throughout the first year as they show their inaptitude for the work at hand.

"The bridge and structural industry being a technical industry places these men in a position where the American Bridge Company can draw on the personnel for such men as are needed in the Contracting, Operating and Erecting Departments, as the need for such men arises in these departments; and throughout our organization we have men in supervisory capacity who have been recruited, passed through the intensified course, and have served in the drawing room as a ground-work for their future development."

The other plan is one which has been used for some time by the City of Los Angeles for the training of not only engineering employees but workers in almost every department of public service, and which has been worked out in conjunction with the University of Southern California. Under the auspices of the School of Government of this University a great variety of courses, a large number of engineering courses among them, are offered at night. Each City Department then prepares a list of approved courses for that particular

department and the employees are encouraged to enroll for one, or sometimes more, of these courses.

At the time of enrollment each employee must bear the full cost of the course himself, but if he completes the course with a passing grade and is still in the employ of the City six months after completion of the course, he is reimbursed in full.

A great many city employees are availing themselves of this opportunity for self-advancement, and it is interesting to note that a number of private concerns in and near Los Angeles, several of them companies employing civil engineers, are encouraging their employees to take these courses and in a number of cases are undertaking to defray at least a part of the cost themselves.

Suggestions for Meeting the Need

In suggesting methods for employee training in civil engineering care must be taken not to overlook the tremendous breadth of this field. Probably no other branch of engineering is as diversified as is civil, embracing as it does such almost unrelated divisions as hydraulic engineering, railroad and highway engineering, and structural engineering, to mention only a few. A detailed program suitable for one of these divisions might be entirely unsatisfactory for another. There are, however, a few general suggestions which can be made.

The larger organizations, those employing perhaps several thousand men, might very well develop their own employee training programs as has been done so successfully in other fields of engineering, notably that of electrical engineering. If this were done such a program could be planned to meet the specific needs of the individual concerns. The course could be made just as elaborate as appeared advisable, and training could be on either a productive or non-productive basis, whichever seemed best. The instructors could be drawn from the company's engineering staff and thus would be not only men of experience but men who were entirely familiar with the particular problems which that company had to face. If it were found desirable, all recent graduates could be started on a general training course and from that transferred to more specialized courses as they displayed special aptitudes.

In the case of the smaller companies, the problem is somewhat different. Ordinarily they would not be able to afford much in the way of a training program for employees. For them possibly the best plan would be one similar to that in use at present by the City of Los Angeles. In most cases there are one or more engineering schools located near industrial centers. Many of these offer night courses at present and probably more would do so if there were

sufficient demand for them. They could offer almost any type of course that was desired and if the regular staff of the school was too small to handle all of these additional courses it should usually be possible to secure the services of competent practicing engineers as special instructors. By encouraging their employees to take these courses and by offering to pay a part, if not all, of the cost themselves, even the smaller companies should be able to work out reasonably adequate employee training programs, and the cost would not be excessive.

There are, of course, a large number of concerns employing civil engineers which are too far removed from centers of engineering education to avail themselves of such an opportunity. The correspondence type of course hardly appears suitable for the purpose and, therefore, it would seem that these companies must attempt to solve their own problem. It would, however, be a small company indeed which would not find it worthwhile to spend a little effort and time and money in organizing a training course for the betterment of its own employees.

REPORT: PROGRESS IN ENGINEERING EDUCATION
1940

Society for the Promotion of Engineering Education

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Introductory Note: This sixth annual Progress Report continues the record of significant trends, developments and events in engineering education. Former reports appeared in February 1936, April 1937, June 1938, May 1939 and June 1940.

Contributions from half a hundred "Leaders of S. P. E. E."—principally officers and chairmen—were reviewed by the members of the committee. In their returns about a third of the items are marked (+) as indicating a significant trend; another third are uniformly marked (—) as "merely factual news without special significance or else unsupported opinions or hopes." Non-agreement as to the remainder necessitates decision by the chairman.

Much interesting "news" of the doings and plans of various schools and committees has not found a place in this *Progress* Report, although showing in the aggregate a constructive and progressive spirit. In some borderline cases items have been retained as they present methods or activities which may contribute to progress by commending themselves for emulation.

The committee is deeply appreciative of the interest and effort of the contributors which render the Report a selective composite of the observations of educators in key positions.

A PROGRESS CONVENTION

The crowning event of the S. P. E. E. year is the Annual Meeting; the 1940 meeting at Berkeley was notably a Progress Convention. The keen discussion at a score of Conferences (Dec. '40, p. 279; Jan. '41, p. 396) * in four score sessions ("hackneyed subjects were

* Reference to JOURNAL OF ENGINEERING EDUCATION.

seldom included"); the dynamic papers in the general sessions; the Presidential address; the keynote topic "The Unfolding Obligations of Engineering Education"—all are animated by a common sentiment and have a common aim, Progress. This all pervading spirit is revealed as one peruses the record in the successive issues of ENGINEERING EDUCATION. A few instances are cited.

Dean Ferguson in his Presidential address (Sept. '40, p. 6) traces the progressive objectives or philosophy of engineering education through a century. The successive stages are revealing: "to give farmers and mechanics such scientific knowledge as would enable them to become skillful in their professions"; to span the Grand Canyon gap between science and industry (industrial application of science was revolutionary; science was degraded; educational institutions would not surrender lofty thought to lowly application; schools of applied science went down through neglect); but science must be a producer; engineering projects must be technically practicable, also economically sound; social and economic orientation to intelligent service is essential; ever growing service must meet the needs of mankind; the spirit of research and unshaken faith must continue to advance. "Engineering practicality, engineering economy, and the adaptation of technology to social good, develop upon the engineer. The philosophy of engineering education advances to new levels."

Dr. Steinman in vigorously presenting a vigorous "Engineer's View of Engineering Education" names present deficiencies and makes definite proposals for higher standards (Sept. '40, p. 18).

President Sieg of the University of Washington, commended the progress in education which engineering has made when he said "It would be a good thing to permit many college students to take some of your courses, not to become engineers or even technicians, but simply to learn how to be students" (Oct. '40, p. 107).

Dean Derleth "selected a less spectacular trend in the Unfolding Obligations of Engineering Education, the problem which increasingly faces professional schools; the insistent quest by parents for professional training when their children are endowed only for a trade or craft, or at best a semi-professional vocation" (Oct. '40, p. 95).

The retiring President in recent comment on the convention says, "S. P. E. E. is a *working* society. Its program of conferences gives multiple opportunities to comment upon excellent work and significant progress. Some new features were—

"The Labor Relations Committee gave a 'first' program, recognizing the necessity for better knowledge of this subject by engineers.

"A panel discussion on Aims and Scope of Engineering Education introduced a new procedure which may become a vitalizing factor in our conventions."

Sections and Branches

The chairman, Dean Enger, reports that some of the nineteen sections have held two-day or three-day meetings with programs divided into division and group conferences. Other sections have had one-day meetings in which the programs were, in most cases, of a more general nature. Discussion of problems of instruction with men from other institutions, and the exchange of experience have been stimulating and valuable to all (Sept. '40, p. 69).

As outstanding should be mention of the meetings of the Texas, the Allegheny, the North Midwest, the Kansas-Nebraska, the Pacific Southwest, and the Pacific Northwest Sections; all of these meetings were two or more days with excellent programs and good attendance.

The Proceedings of the meeting of the Allegheny Section in October are issued in a 90 page pamphlet by the Carnegie Institute of Technology. The topic, The Coördination of Engineering Curricula, is treated by a coördination of papers based principally on the report on Aims and Scope of Engineering Curricula.

Seventeen Branches are organized in institutions in various parts of the country. Some hold active meetings monthly; others less frequently. It is unfortunate that the programs for the branch meetings are rarely published in Engineering Education.

Engineering Defense Training—Comment

The engineering defense training program being carried on under the direction of the United States Office of Education has been reported in successive issues of the Journal of Engineering Education. It is not proposed to summarize them here, but to present the views of educational commentators.

The Universities in the present emergency constitute the greatest single source of help for the country in an objective way; I am thinking of agencies for doing work. For example, the engineering defense training program could not have been possible with anything like the success of organization, facilities for performance and time factor without the existence of the technical schools.

The effect on engineering colleges of the national defense program is the important event of the year. They have opportunity to prove their value to the nation. War would create a great demand for engineers; but war or no war a reconstruction period is ahead for America and the world.

Selective Service. The most significant item of progress in engineering education that has come to my attention is the recognition in the selective service act and its administration of the vital importance of engineers and of engineering education in national defense and in the industrial efficiency essential to national defense.

Adaptability. It is noteworthy that the colleges are meeting the particular situations in their own localities, thus showing initiative and adaptability in using their facilities to train men to serve the industries in which they are more or less closely related.

Wastage in Present System. The national defense program has revealed a shortage of craftsmen which raises anew the old problem of excessive wastage of students in the program of training engineers. I suspect that we are kicking out of our engineering schools thousands who might have become highly skilled craftsmen if given an opportunity. An education system that wastes 75 per cent of its raw material is not one to be proud of.

Maintenance of Standards. Oversupply of engineers was feared a few years ago and engineering schools were cautioned against large enrollments. Now they are being urged to speed up technical training and expand their facilities. Both points of view are probably wrong; steady, normal growth is the best solution to our long-range problem. Institutions should be extremely careful in protecting proper standards against pressures which are already developing.

Federal Control. The trend is beginning toward greater federal participation in engineering education. Greater federal control in such education must be carefully guarded against. There is a possibility of submerging the regular, normal, four-year program in engineering with the emergency defense training courses. A tempting bait is offered in the form of federal subsidy and the possibility of "selling one's soul for a mess of potage" should be kept in mind.

Observations by Some Past Presidents

Dean Cooley. One thing I see is the likely coming to pass of a dream—an education for the engineer befitting his importance in the world of today. Every man should first have an education that teaches him how to live in order to get the most out of life for himself and to give the most to others; and second, to teach him how to earn money with which to accomplish the first. That is, a general education and a professional education. Why should not the engineer be interested in helping operate the machine he, himself, created—in this case, our modern civilization?

Dean Pegram. Although my contacts with engineering and engineering education have lessened, I get the impression that engineering education is going forward rather steadily. There are improved text books and I believe a steady advance in the teaching of some of the fundamental subjects, applied mechanics, for example, also there is more attention given to research. I have some misgivings as to the improvement of the general professional and financial status of the engineer since the beginning of the depression.

Dean Anderson. I am very strongly impressed with the feeling that one of the factors in the *real* progress which engineering education is making is the fact that the S. P. E. E. goes steadily ahead, studying carefully and conservatively its own problems, and yet it refrains from labelling its methods as "progressive."

ENGINEERS' COUNCIL FOR PROFESSIONAL DEVELOPMENT (May '41, p. 638)

E. C. P. D. has now an eighth constituent, The Engineering Institute of Canada, making it still more broadly representative of the engineering profession.

A Committee on Principles of Professional Ethics has recently been established. It continues and enlarges a former committee of American Engineering Council and retains the former chairman, Dugald C. Jackson.

The Committee on Student Selection and Guidance is making headway in the counseling of high school students by local engineering groups and in other ways. The chairman, Dean Sackett, is chairman also of the S. P. E. E. Committee on Student Selection and Orientation which reported on "Discovery of Promising Freshmen" at the Berkeley Convention (Oct. '40, p. 133). (A related paper is "Promise; Its Discovery in the Young Engineer," by Professor Bangs (Oct. '40, p. 118).) The securing of qualified freshmen is basic to the quality of education and of the profession; it does not take second place even to accrediting of curricula.

The Committee on Engineering Schools reports through its chairman, Dean Potter, that as of October 24, 1940, the Engineers' Council for Professional Development has accredited 542 undergraduate engineering curricula in 125 institutions. 164 curricula were inspected but not accredited, and action on three curricula is pending.

While the major task of the E. C. P. D. Committee on Engineering Schools was completed in October, 1939, the activity of this Committee during the past year has included visits to 22 institutions, the inspection of 32 curricula not on the accredited list, and the reappraisal of 70 curricula previously accredited. The visits of

inspection by E. C. P. D. Committees since 1935 have been successful in securing for the benefit of the public a fairly accurate list of sound engineering curricula. It is hoped that the accrediting procedure and the informal advice given by the Committee to institutions requesting it have resulted in better standards, improved facilities and in a more sound educational background for practicing the engineering profession.

The Committee on Professional Training (O. W. Eshbach, chairman; now succeeded by S. D. Kirkpatrick) reports a preliminary study of coöperation of various agencies in aiding the junior engineer. To aid employed graduates in the Metropolitan (N. Y.) District the Committee has issued a directory of 34 subjects (Engineering, Science and Non-engineering) available principally in evening courses in eight institutions. It regards professional training as a joint responsibility of professional societies, of employers, and of the schools.

The president of an engineering school, in contributing to the Progress Report, notes "a movement toward a closer relationship between recent engineering graduates and their respective alma maters. Some institutions have organized procedures to facilitate such relationships."

The *Committee on Professional Recognition* (C. F. Scott, chairman) urges that the engineering student acquire an understanding of the qualities which characterize a profession and of the engineering profession, particularly as to its development, its organization and ethical attitudes and to legal registration. To this end it urges that engineering societies contribute through student branches, and engineering teachers by both formal and informal presentation. A preliminary report on the Teaching of Ethics in Engineering Schools made by the A. S. M. E. shows three methods of systematic presentation in 49 schools—in course in 39; in lectures by practising engineers in 24; in student branches in 21.

The A. S. M. E. findings accompany the annual report of the committee which is part of the Eighth Annual Report of E. C. P. D., October 1940 (55 pages).

Aims and Scope of Engineering Education

The S. P. E. E., courageously undertaking an appraisal of its own basic purposes, produced a notable report on the Aims and Scope of Engineering Curricula (Mar. '40, p. 555). The report, which conveys two major recommendations, (1) continuation of the present general plan of engineering education of four years of integrated programs at the undergraduate level followed by postgraduate work, and (2) a broadened base for these programs so as to include

more and better directed work in the basic sciences and humanities, was the subject of a half day session at the annual meeting at Berkeley. This comprised a panel discussion by members of the committee and others, followed by extended discussion from the floor (Dec. '40, pp. 322–357). Support for the major conclusions and recommendations were general with dissent from a few that four years should continue to be the normal period of undergraduate curriculum. There is wide spread agreement that the "base of engineering education should be broadened" by giving more emphasis to basic sciences and humanities which requires that some of the more advanced work in applied science be transferred to post-graduate years. As the report is formulated in general terms and presents broad recommendations rather than specific proposals, it is to be intepreted and applied in terms of local conditions and individual views on matters of detail. Like other basic documents its effects may be felt over a considerable period rather than immediately. Three institutions were proceeding with the adoption of its major recommendations within a few months of its appearance. (Copies of the Report may be obtained from the Secretary.)

The Teaching of English

A report from the Committee on English (with aid of a grant from the Carnegie Foundation for the Advancement of Teaching) was reprinted as a special supplement to the June, 1940, issue of Engineering Education. This broad gauge report was widely circulated among engineering teachers, libraries, practicing engineers, teachers of English and administrators of departments of English. The encouraging response proved that "problems considered in the reports are also the general problems of undergraduate instruction in English and the suggestions in the report met approval."

Definite Results are indicated by Chairman Creek; (*a*) A School for Teachers of English in Engineering Colleges, scheduled at the University of Michigan for three weeks following the S. P. E. E. Convention in 1941 is sponsored jointly by the University and the Society. Teachers of English Composition, English Literature and Speech will discuss the problems presented in the report (Apr. '41, p. 566). (*b*) The National Council of Teachers of English has asked the coöperation of the S. P. E. E. group in a study of the preparation of teachers of undergraduate students. (*c*) A less tangible but not less real result of the report is the increasing interest in the problems of English for engineers among all concerned with engineering education.

Chemical Engineering

The whole-hearted coöperative efforts of chemical engineering educators resulted in two major publications in 1940, reports chairman Koffolt.

"Applications of Chemical Engineering," edited by Harry McCormack (Illinois Institute of Technology) was the culmination of conferences of the chemical engineering division on laboratory work. It is the final collaboration of twelve professors from nine universities.

Collected papers on the "Teaching of Chemical Engineers," published by the American Institute of Chemical Engineers resulted from the Second S. P. E. E. Summer School for Chemical Engineering Teachers at Pennsylvania State College, June 1939, under the directorship of Professor Robert C. Kintner (Illinois Institute of Technology). The compilation was organized by the Projects Section of the Chemical Engineering Education Committee, A. I. Ch. E., under the direction of Joseph C. Elgin. The papers indicate a healthy progress since the first school at the University of Michigan in 1931.

A definite feeling has arisen that the chemical engineering departments are not contributing their share to students in other departments; also that adequate service courses are not available to chemical engineering students. Joint coöperative conferences should be held with other divisions as the emphasis in chemical engineering education is not on factual knowledge but the integration of the fundamentals of mathematics, physics, English, chemistry, economics, etc., to fit the student for diversified industry with its many problems which have not found their solution in text or hand books.

Mathematics

Several institutions report closer coöperation between mathematics and engineering departments, and mathematics and physics. In the latter the vocabulary, the constants, the timing of particular subjects in the two departments are bringing fruitful results through coöperation.

The mathematics section of the Kansas-Nebraska Regional group, formed in 1938 considers, (*a*) engineering application of mathematics, and (*b*) problems of teaching, such as type of text books, scope of courses, methods of presentation, difficulties, and failures in mathematics. Well attended meetings focus attention on the mathematical needs of engineering students and the special problems of such students. Contacts with engineering instructors have been stimulating to the mathematics teachers (Conference Report, Dec. '40, p. 310).

The Coöperative Plan

No radical changes have occurred in recent years. "Trends in Coöperative Education" in *School and Society,* July 3, 1937, is fairly descriptive of present practice. Nine out of ten coöperative colleges have adopted a five year program and four out of five have alternate periods of eight or more weeks with one-quarter and semester calendars predominating. Present industrial conditions facilitate training opportunities. Of nineteen colleges offering cooperative degree programs in engineering seventeen are accredited.

What Makes the Coöperative Plan Function? was the topic of a stimulating panel discussion conducted by the S. P. E. E. Branch at Northeastern University (Mar. '41, p. 535).

Labor Relations

The engineer of today is expected to speed production; of the two vital elements we have machines pretty well organized but our methods of dealing with labor problems are archaic. The committee last year induced representatives of labor organizations and of the manufacturers association to state their problems and views on labor relations. This year it plans to bring the present deplorable conditions forcibly to the attention of engineering educators and to suggest ways in which they may help to improve labor relations (Dec. '40, p. 310).

Engineering Research

The major activity ending with the 1940 convention was to take stock of certain aspects of current engineering research in the United States.

"Our Research System," a paper by Harold Vagtborg, summarizes the situation (Jan. '41, p. 421).

Titles of Graduate Engineering Theses, numbering 1141, submitted in 1938–39 in 73 engineering schools in the United States and Canada, may be helpful in locating research workers and facilities in relation to national defense. They may also be serviceable to the supervisors of graduate research (Mar. '41, p. 499; Apr. '41, p. 586).

Organization of Research Facilities is a title in Dean Moreland's paper on Public Welfare (Sept. '40, p. 48).

Trends in a Decade

The more important trends during the past ten years as observed by Dean Butler were presented by him to the Los Angeles Section of the A. S. C. E. as follows:

Engineering college entrance requirements are being raised.

Recent developments in science and technology are being incorporated into engineering curricula.

Industrial or trade courses are being dropped from engineering curricula.

A desire to give engineering students broader, less technical training is crystallizing.

The conviction that engineering curricula must be lengthened is gaining ground.

Under the second item he offers a partial list of new appearances in civil engineering curricula; photogrammetry, soil mechanics, statically indeterminate or rigid frame structures, administration of large enterprises and personal management, city planning, differential equations.

He concludes, "Engineering education is certainly in a state of flux. May it never become static."

Departmental and Educational Items

The Mechanical Engineering Division notes increase in number of meetings and in the influx of papers. Laboratory courses are being better synchronized with the classroom. "Unit Operation Apparatus" experiments in laboratory instruction are increasing —a method sponsored by L. M. K. Boelter of the University of California (Dec. '40, p. 281 and p. 315; Nov. '40, p. 213).

Publications by Two Divisions of the Society are issued several times a year; The Journal of Engineering Drawing and the S. P. E. E. Civil Engineering Bulletin. They are "planographed" on letter size pages. Typical issues contain half a dozen freshly contributed articles, with illustrations and diagrams.

The Division of Engineering Drawing supplemented its sessions at Berkeley by holding February conferences, in 1940 at Chicago and 1941 at St. Louis; attendance at the latter was about 60, representing half as many schools and several industries; the principal topic related to air craft design.

In the Middle Western region these trends are observed:

1. *Division of the four-year program* into a junior division and a senior division; a student must show satisfactory scholastic ability in the junior division before he will be promoted to the senior division and become a candidate for a baccalaureate degree.

2. The *Students' counselors* make more intelligent use of such aids as A. C. E. tests, high school grades, and grades made while in the junior division.

3. *The common freshman year* is widely accepted for the several curricula in engineering and considerable progress is being made toward the adoption of a common sophomore year.

In Vocational Education there is notable advance at the secondary school level. The vocational high schools in the more progressive states like Connecticut, Massachusetts, and Minnesota were able to assume responsibility for a $14,000,000 program of industrial training needed for national defense, whereas in 1917–18, the corresponding burden fell to the engineering colleges, which set up special classes for the trades training.

In Placement of Graduates there is improvement in methods and organization; whereas ten years ago departmental heads assisted in procuring employment for their graduates, today a placement officer has well developed techniques and procedures. Graduates get jobs more readily, and they get jobs better suited to their individual aptitudes.

Two Preliminary Years. One instance of progress in engineering is the non-acceptance of a program, strongly urged in recent years, to require two years of general education for entrance to an engineering course. This outcome coupled with a continued growth in graduate work in engineering indicates a trend toward a more definite body of intellectual disciplines called engineering.

E. H. FLATH,
D. C. JACKSON,
C. C. WILLIAMS,
C. F. SCOTT, *Chairman.*

NEW MEMBERS

BETTENCOURT, WILLIAM, Director of Mechanical Drawing, Belmont Senior High School, Belmont, Mass. R. D. Douglass, E. H. Temple.

CAREY, CLIFTON O., Associate Professor of Geodesy and Surveying, University of Michigan, Ann Arbor, Mich. C. T. Olmsted, R. A. Dodge.

CREESE, MYRON, Professor and Head, Dept. of Electrical Engineering, University of Maryland, College Park, Md. R. B. Allen, L. J. Hodgins.

CROWDER, BERT A., Instructor, University of Minnesota, Minneapolis, Minn. C. A. Koepke, R. E. Summers.

HOLTBY, FULTON, Assistant Professor of Mechanical Engineering, University of Minnesota, Minneapolis, Minn. C. A. Koepke, R. E. Summers.

GOULD, JAY R., Assistant Professor of English, Rensselaer Polytechnic Institute, Troy, N. Y. H. H. Nugent, Frederick Abbuhl.

HYSLOP, WILLIAM H., Professor of Physics, University of Denver, Denver, Colo. Chester Russell, F. L. Bishop.

JOHNSON, WALTER A., Instructor in Machine Design, Cornell University, Ithaca, N. Y. C. D. Albert, P. H. Black.

KEITH, GERALD M., Assistant Professor of Mechanical Engineering, University of Florida, Gainesville, Fla. P. L. Reed, U. C. Ebaugh.

KNUDSON, CLARENCE M., Chairman, Dept. of Chemical Engineering, University of Denver, Denver, Colo. Chester Russell, F. L. Bishop.

MCFARLAN, HAROLD J., Assistant Professor of Geodesy and Surveying, University of Michigan, Ann Arbor, Mich. H. Bouchard, C. T. Olmsted.

MENEFEE, FERDINAND N., Professor of Engineering Mechanics, University of Michigan, Ann Arbor, Mich. C. T. Olmsted, F. L. Everett.

MILLER, JOHN B., Assistant Professor of Electrical Engineering, Bucknell University, Lewisburg, Pa. Re-admission.

STEARNS, JOYCE C., Professor of Physics, University of Denver, Denver, Colo. Chester Russell, F. L. Bishop.

VAN DYKE, JAMES R., Special Instructor Secondary C. P. T. Course, Ground School, Texas Technological College, Lubbock, Texas. M. E. Farris, D. B. Jett.

YOUNG, EDWARD, Assistant Professor of Geodesy and Surveying, University of Michigan, Ann Arbor, Mich. C. T. Olmsted, R. A. Dodge.

Active institutional membership:

NEW MEXICO SCHOOL OF MINES, Socorro, N. M. C. E. Needham, President.

227 individual members + 3 institutional members.

SECTIONS AND BRANCHES

The **Indiana-Illinois Section** of the S. P. E. E. met at Purdue University, April 26.

Upon invitation of Northwestern Technical Institute, the 1942 meeting of the Indiana-Illinois Section is to be held at Evanston.

The officers for the year 1941–42 are:

George A. Maney, Northwestern University—*Chairman*
P. E. Mohn, University of Illinois—*Vice-Chairman*
Edward F. Obert, Northwestern University—*Secretary-Treasurer*

An Executive Committee includes all the officers and in addition—

M. B. Reed, Illinois Institute of Technology
Ronald Rich, Notre Dame University
O. L. Stock, Rose Polytechnic Institute
C. S. Cutshall, Purdue University

W. A. KNAPP.

At the last meeting of this year the **Lafayette Branch** of the S. P. E. E. elected the following officers for next year:

Chairman: H. W. Savage
Vice-Chairman: E. L. McMillen
Secretary-Treasurer: W. G. McLean

WM. G. MCLEAN.

The **Middle Atlantic Section,** S. P. E. E., held their Spring Meeting on May 3, 1941 at Villanova College, Villanova, Pennsylvania. The meeting was attended by 165 men and 62 women. The program, presented by Villanova College, was under the direction of Dean J. S. Morehouse.

The morning session, under the direction of Chairman Charles G. Thatcher of Swarthmore College, consisted of greetings by the Reverend E. V. Stanford, President of Villanova College, and an address by Dean Thorndike Saville of New York University on the "Effects of the Engineering Defense Training Program on Engineering Schools."

Luncheon was served at 1 P.M. and followed by an afternoon technical session. The afternoon program was divided in three parts. The first session, under the chairmanship of Dean G. F. Bateman, Cooper Union, discussed the general topic "Methods of Teaching the Basic Science Courses for Engineers." The speakers were Professors R. E. Kirk, Brooklyn Polytechnic Institute, R.

A. Patterson, Rensselaer Polytechnic Institute, and A. Dresden, Swarthmore College.

The second session, under the chairmanship of Professor P. B. Eaton of Lafayette College, discussed "Technique of Handling Engineering Laboratory Classes." The speakers were Professors E. K. Timby, Princeton University, L. H. Pumphrey, Rutgers University, A. P. Colburn, University of Delaware, and H. F. Roemmele, Cooper Union.

The third session, under the chairmanship of Dean J. A. Goff, University of Pennsylvania, was on the topic "What Engineering Courses Should Be Prescribed for Students Outside Their Major Field." The speakers were Professors J. K. Finch, Columbia University, H. T. Ward, Drexel Institute, I. Travis, University of Pennsylvania, and F. D. Carvin, Newark College of Engineering.

Dinner was served at 6 P.M., followed by an entertainment in which the Franklin Institute of Philadelphia demonstrated its show on Air Dynamics.

The meeting was very well planned and all enjoyed the very beautiful campus of Villanova College.

FRANK D. CARVIN,
Secretary.

The annual meeting of the **Missouri Section** of S. P. E. E. was held at Columbia, Missouri, on April 18 and 19, 1941.

The officers for the year 1941–42 are:

Chairman—Prof. E. W. Carlton, Missouri School of Mines, Rolla, Missouri.

Vice Chairman—Prof. R. B. B. Moorman, University of Missouri, Columbia, Missouri.

Secretary—Prof. T. R. Ball, Washington University, St. Louis, Missouri.

ROBERT B. B. MOORMAN,
Secretary.

The **North-Midwest Section,** which includes Duluth Junior College, Iowa State College, State University of Iowa, Lawrence College, Marquette University, Milwaukee School of Engineering, Michigan College of Mining and Technology, Morningside College, University of Minnesota, Trinity College and The University of Wisconsin, will meet at Madison, Wisconsin, October 11 and 12, 1941, for their annual Section meeting. Committees have been appointed and preparations for making this meeting an important event are under way at The University of Wisconsin.

EDMUND D. AYRES, *Chairman,*
Publicity Committee.

The 1941 meeting of the **Rocky Mountain Section** was held on the campus of the University of Denver on April 26, 1941. The papers and discussion dealt with various phases of the topic "The Functions of Engineering Colleges in Defense Training."

Officers elected for 1941–42 are: *Chairman,* Professor G. H. Sechrist; *Secretary,* Professor McGaw; both of the University of Wyoming. The 1942 meeting will be held at the University of Wyoming, Laramie, probably on May 2, 1942.

CHESTER RUSSELL, JR.,
Secretary.

Since the annual meeting of the **Southeastern Section** of the S. P. E. E. was held at the University of Kentucky on April 25 and 26, it was decided that this meeting should also serve as the annual meeting of the Kentucky Section. On Friday morning, Prof. W. B. Wendt of the University of Louisville discussed a paper by Dean Blake R. Van Leer of North Carolina State College on "The Places of the Engineering Colleges in the National Defense Program," and on Saturday morning Professors Ernst and Amidon discussed, from the floor, the paper of Dean L. H. Johnson of the University of Mississippi on "Common Sense in Engineering Education." Representatives of twenty colleges in the southeastern part of the United States attended the two-day meeting and the papers presented were both interesting and instructive.

On Saturday morning, at the conclusion of the general meeting, a short business meeting of the Kentucky Section was called to order by President Jett in Room 209 of McVey Hall. The minutes of the last meeting were read and approved and the treasurer's report for the past fiscal year was given.

President Jett appointed a nominating committee composed of Professors Nollau, Ernst and Amidon to submit nominations for officers for the coming year. After due deliberation the nominating committee reported, submitting the following list of officers for the coming year:

Dean F. L. Wilkinson, Jr., University of Louisville—*Chairman*
Prof. J. W. May, University of Kentucky—*Vice-Chairman*
Prof. L. L. Amidon, University of Louisville—*Secretary-Treasurer*

Motion was made and seconded that the secretary be instructed to cast one ballot for the candidates, electing them unanimously.

The meeting adjourned at 12:45 to the Student Union cafeteria for lunch. Following lunch an inspection was made of the Wenner-Gren Aeronautical Research Laboratory and the departmental laboratories of the College of Engineering.

Secretary-Treasurer's Financial Report:

Balance turned over to present treasurer on November 4, 1939	$3.70
Expenses incurred during past year	none
Funds received during the past year	none
Balance on hand as of April 26, 1941	3.70

In will be noted that there was no money received by the treasurer during the past year. In the past the national organization has reimbursed the local chapter to the extent of 50¢ for each new membership received. This practice, however, was discontinued about one year ago.

JAMES W. MAY,
Secretary-Treasurer.

At a meeting held at Ithaca, New York, on April 26, 1941 the **Upper New York State Section** of S. P. E. E. was organized. At this meeting were eight representatives from Syracuse University, one each from Clarkson and the University of Rochester and fifteen from Cornell.

After a dinner a constitution was adopted and the following officers elected for the year 1941:

Chairman—E. F. Berry (Syracuse)
Vice-Chairman—H. A. Weiss (Clarkson)
Secretary-Treasurer—G. E. Grantham (Cornell)

After the business session brief remarks were made by Professor Weiss of Clarkson, Professor Conley of Rochester and Dean emeritus Kimball of Cornell. The main address of the evening was made by Dean Louis Mitchell of Syracuse. Dean Mitchell extended an invitation to the section to hold the next meeting at Syracuse University in the Fall of 1941. This invitation was accepted.

G. E. GRANTHAM,
Secretary.

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G-E Campus News

GIANT ATOM SMASHER

SO powerful that its atom-smashing beam of ions would melt an ordinary brick as fast as a blowtorch would melt a pound of butter will be the U. of California's new 100,000,000-volt cyclotron. The 4900-ton giant—16 times more powerful than the present outfit—will generate atomic energies greater than any now in existence except in distant stars or elsewhere in cosmic space.

Atomic particles will be fed into a circular chamber where they will receive successive "kicks," whirling them around in continually widening circles until they reach a window or port on the side of the chamber. The element to be bombarded will be placed over this window where it will receive the full force of the ion beam.

For this machine General Electric is building electric equipment, which will occupy the space of a two-story house. The chief function of this equipment will be to make ordinary electric current capable of operating the giant atom smasher.

DETECTIVE STORY

ALBANY HOSPITAL was in an uproar. The technicians in charge of the hospital's radium supply had lost a radium "needle"—only 3.3 milligrams to be sure, but enough to burn a person seriously if the needle were caught for long in his shoe or clothing.

An appeal for help was sent to the General Electric Research Laboratory in Schenectady for a "Geiger Counter"—an electric "ear" which detects and amplifies the otherwise inaudible "explosion" of the radium as it breaks down.

When Dr. C. W. Hewlett (N. C. State, '06) of the G-E Research Laboratory entered the suspected operating room, the counter immediately began to "cluck" its warning of radioactivity nearby. After a false start, the counter took to the trail like the Hawkshaw it is, and eventually, as Dr. Hewlett lowered it to the floor in front of a radiator, the clucks became barks. And there, snuggled against the wall under the radiator, was the missing radium.

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